RADIO NEWS

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July
1923
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Edited by H. GERNSBACK

HOOK-UP NUMBER

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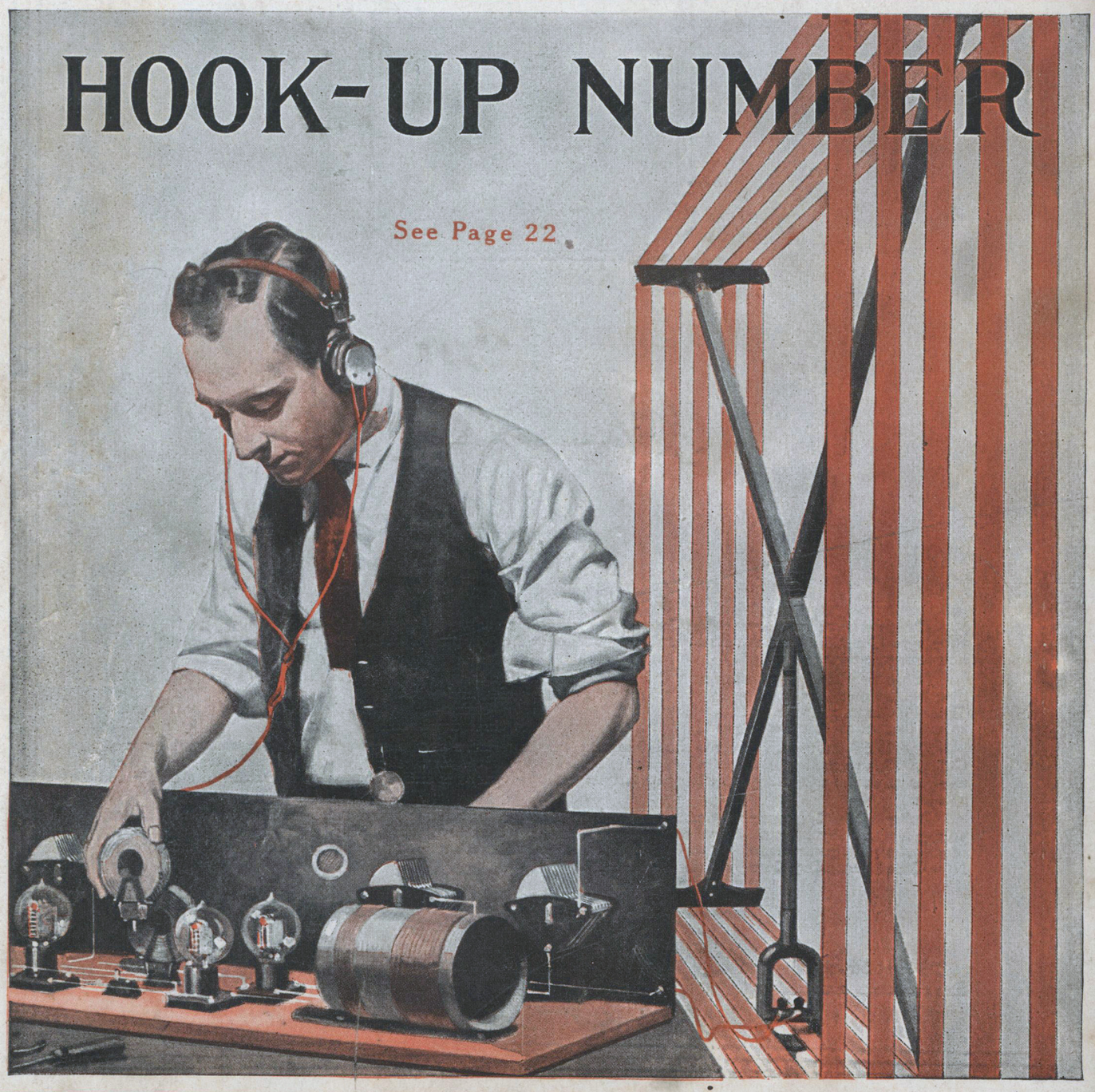

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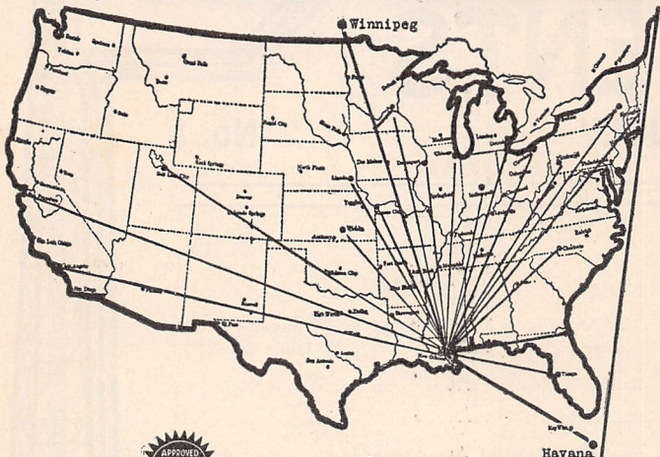

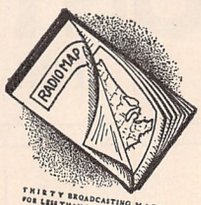

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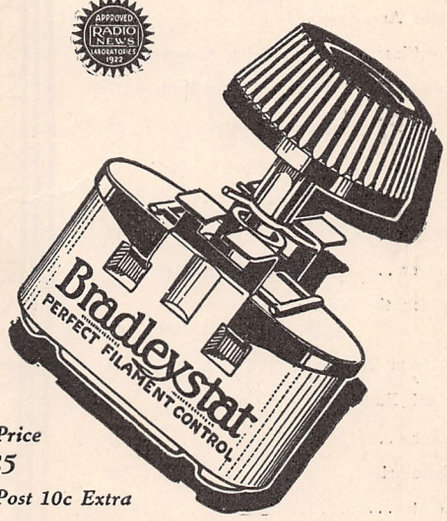

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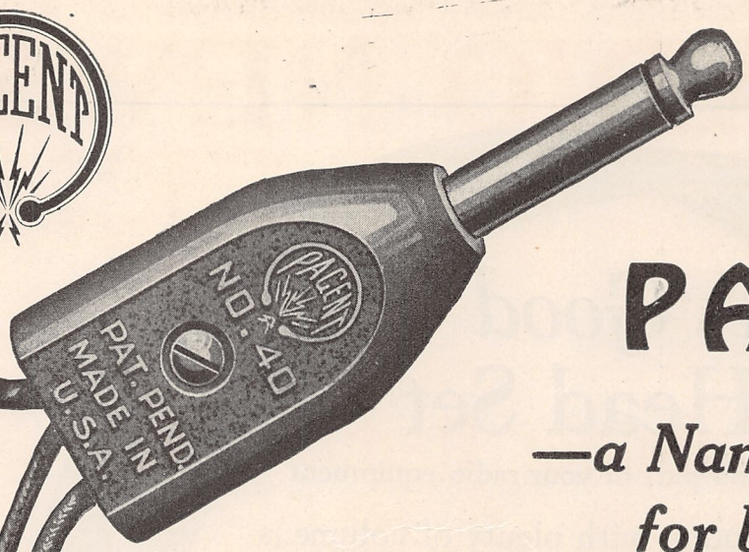

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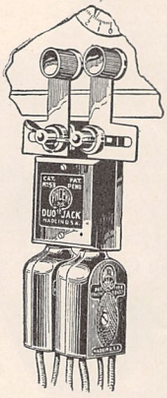

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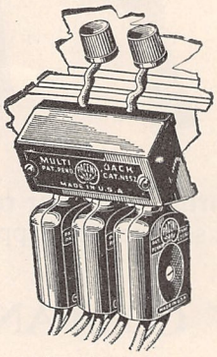

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Write for Descriptive Bulletin N-7

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RADIO ESSENTIALS

RADIO NEWS

H. GERNSBACK—Editor and Publisher
ROBERT E. LACAULT—Associate Editor

EDITORIAL AND GENERAL OFFICES, 53 PARK PLACE, NEW YORK

Vol. 5 JULY, 1923 No. 1

Summer Radio

THIS year, no doubt, will see many more radio stations in operation, by far, than any previous year in the history of Radio. There was a time when summer radio was tabooed because in certain sections of the country, particularly in the South, it was practically impossible to operate a set during the summer months.

This, however, is not the case today, as atmospheric conditions, which of course remain the same year in and year out, are not at all as destructive to radio as they were years ago, due, naturally, to the advance of the art, in a great measure, and also due, in part, to our aerials, which are not as large as they used to be in former years.

The old-time amateurs had aerials from 100′ to 200′ long and more, using anywhere from two to eight wires. This naturally gave rise to a much greater amount of static reception than is the case with the small 75′ or 100′ single wire antenna which is the vogue now, all over the country.

For all practical purposes, you might set up the axiom that *"the smaller the amount of wire exposed to the atmosphere, the less the static will bother the reception."* This can be readily proven by using a small loop. The writer has frequently been able to use a moderate-sized loop, about 4′ square, on a 5-bulb outfit, while a thunderstorm was raging overhead. Nevertheless the music and talk from a broadcasting station 15 miles distant came in surprisingly well, although the loop was placed inside of a steel building. It is true that every once in a while during a terrific thunderstorm there would be a crackling, clattering noise, but this was not as frequent as one might suppose.

The static interference immediately before and immediately after the height of the storm was not sufficient to hamper broadcast reception in the least, and the concert, with a lecture following, was enjoyed the same as usual, despite the storm.

Now such conditions are, of course, unusual, because even in the middle of summer there is not a thunder-storm every hour of the day or, for that matter, every evening. Furthermore, it is not always possible for every one to put up a loop. For instance, the crystal set user in the summertime experiences some little difficulty in reception, although, with a single aerial 75′ long, he is hardly able to tell the difference in reception in the spring from that in the summer. In other words, on the hottest and most sultry day, his reception is only from 10 to 15 per cent less satisfactory than on the coldest winter day. Then, too, the crystal set user can not take recourse to the loop unless he is within a mile or two of the broadcasting station.

The vacuum tube set user who has a good set, as a rule can do better with a loop than with an aerial. Not only is the loop more directive in that unwanted stations can be eliminated, but the use of the loop also eliminates static greatly, as already mentioned.

We have often been asked, "Is it safe to use the loop in the room during a thunder-storm?" The answer is "YES!" A small loop is no different than any small detached mass of metal in the room. For instance, it is just as safe to touch a metal window screen, play the piano, or carry an iron pail. If you are in a small wooden building, or wooden house, and lightning strikes, all three will be about equally safe, or not safe, as you wish. The human body is an excellent conductor itself and if lightning should strike the room, there are just as many chances that it will strike you if you use a loop, play the piano, or carry an iron pail, as there would be if you were not doing any of these things.

Usually if there is an electric fixture, a water pipe, or radiator in the room, the chances are that lightning will strike these rather than strike you. In other words, operating a loop while lightning is playing around, might be called just as safe as not operating it at all. On the other hand it is preferable not to use an outdoor aerial during a thunder-storm, but ground it, as it will probably be impossible to keep the phones on the ears anyhow.

An aerial equipped with a good lightning arrester does not present any danger. Quite the contrary, it becomes then the very best lightning protector imaginable.

A new use for summertime radio is found in weather prediction. Professor Rothé, of the Faculty of Sciences at Nancy, France, has made elaborate experiments in the study of weather prediction. Charges due to storm clouds give distinctly loud metallic sounds in the receivers, easily recognizable, and varying in intensity according to the violence, duration and distance of electric storms. The reader can himself make these experiments, and by keeping track of the different noises as he hears them in the summer, and comparing such charted data with resultant storms, he will soon be able to tell the weather and storms for a considerable period ahead of time. This branch of Radio has as yet not been closely studied; however, it should form the basis of an entirely new science. H. GERNSBACK.

Some of the Articles that Will Appear in the August Issue

An Interesting Article on "Fading." By Dr. G. W. Pickard.

Detection. By Louis Frank. An explanation of the detector's operations.

A Capacity Coupled Receiver for Short Waves. By Paul G. Watson.

Elimination of Re-Radiation Interference. By D. R. Clemons.

Radio Frequency Receiver Design. By Kenneth Harkness.

Also several others on subjects in which you are greatly Interested.

Health by Radio

By S. R. WINTERS

"I AM a licensed embalmer and I am in a position to see the value of your advice, as our work takes us into many a home where, had such advice as you give been observed, our visit would have been delayed to some future time. I listened to your lecture on burns and their treatment and the next day was able to pass it on to a man with a burned hand and only this morning he called my attention to how rapidly it healed and how little trouble he had with it."

"We had the misfortune of having diphtheria in our family recently. We got a good doctor, followed your instructions, and helped to prevent the spread of that disease."

"The health broadcasts are very instructive, and especially instructive and interesting was the one on smallpox, as it came while our town was passing through an epidemic of smallpox. There was much controversy on enforced vaccination."

"In my opinion there is no better means of broadcasting information for the benefit of the public. Have just completed a station for our local public health doctor. He intends to use this receiving station especially to receive the public health lectures."

"Such a work is of inestimable value in bringing home to your audience that diseases should always be treated by a reputable doctor and not by widely advertised quacks and patent medicines."

SERVICE IS WORLDWIDE

These testimonials, originating in such widely separated states as Florida, Connecticut, Ohio, and Maryland, were extracted from letters received by Surgeon General Hugh S. Cumming of the Bureau of Public Health Service, United States Treasury Department, subscribing to the value of "The Pioneer Health Information by Radio Service of the World." Excerpts from this volume of correspondence embrace 49 typewritten pages, representing expressions from Florida to California, and from Cuba to Canada. Or, putting it differently, "Uncle Sam's Health by Radio," blankets the eastern half of North America. From a point 300 miles out to sea (a vessel having heard a Public Health Service lecture when at that distance from shore) on the Atlantic seaboard, the Gulf of Mexico, the northern coasts of South America, the west coast from Puget Sound to San Francisco and several hundred miles westward on the Pacific Ocean—these are the almost boundless limitations under which the radio telephone operates when dispensing information in the interest of human welfare.

These artificial boundaries, however, have already been broken over and, in a sense, the broadcasting service of this Government agency is of world-wide scope. When

Above Are Mr. Louis Jay Heath, Assistant Director of Educational Work and His Assistant Who Prepare the Lectures To Be Broadcast. Below: Surgeon-General Hugh S. Cumming Is Seen Broadcasting Through Station NAA.

Uncle Sam dispenses "Health by Radio"—if this figure of speech is permissible—the copies of the radio-telephone broadcasts are translated for circulation through foreign-language newspapers at home and abroad. Arrangements effected between the Foreign Language Information Service of New York City and the Public Health Service have made possible the translation of these health lectures into 16 foreign languages, available for publication by 2,000 newspapers, having a combined circulation of 20,000,000 readers. For a period of three months, 153 articles have been released to the foreign-language press in America, this material comprising 83,695 written words. During a corresponding period of time, 46 articles were released for publication in the European press, these compositions constituting 27,404 words. Press clippings received by the Public Health Service show that 1,154 items, consisting of 592,775 words, have been printed by the foreign-language press.

The use of Public Health Information by Radio Service by foreign countries, however, is an incidental outgrowth to the purpose of the existence of this medium of transmission, namely, the widespread and effective dissemination of health information throughout the United States. More thoroughly to accomplish this end, plans are afoot looking toward an expansion of the service. In addition to the one Federal Government and 18 privately-owned wireless broadcasting stations that are already transmitting lectures on how to keep fit physically, the coöperation of approximately 40 other commercial wireless broadcasting stations is under consideration. About 20 stations have already requested this service, and it is anticipated that the enlarged plans will have included the coöperation of 50 broadcasting stations, all told, whose efforts will be enlisted in spreading the gospel of health. Such an expansion contemplates the "blanketing" of health information over the entire United States, from southern Canada to northern Mexico.

The subject matter of the lectures delivered by radio is furnished by experts of the Public Health Service and by other well-known medical writers. In order to adapt it to the radio service it must generally be subdivided and rewritten, and this is done by Mr. Louis Jay Heath, Assistant Director of Educational Work, and representative of the Treasury Department on the Inter-Departmental Advisory Committee on Government Radio, after which it is resubmitted, usually to the specialist who originally furnished the material, but always to Dr. B. J. Lloyd, chief of the division under which the radio service operates, who carefully checks the information for accuracy and questionable matter. After this revision, it is again read by the Executive Officer of the Bureau and finally by the Surgeon General himself before it is allowed to be released.

Although wireless apparatus is in evidence in this room, it merely consists of a radio-telephone receiving set. A conventional telephone is available for relaying the lectures to Radio, Virginia, NAA, this remote-control system being in operation on Monday and Tuesday evenings from 8:05 to 8:20 o'clock, the fifteen-minute periods allotted to "Health Education by Radio." The triangle of towering antennae at Arlington is plainly visible from a window of this room, although four or five miles intervene. From the large aerials held aloft by the three massive towers, these lectures are hurled into space and picked up by distant listeners. While "Public Health Information by Radio Service," as an organized effort, dates from

(*Continued on page* 80)

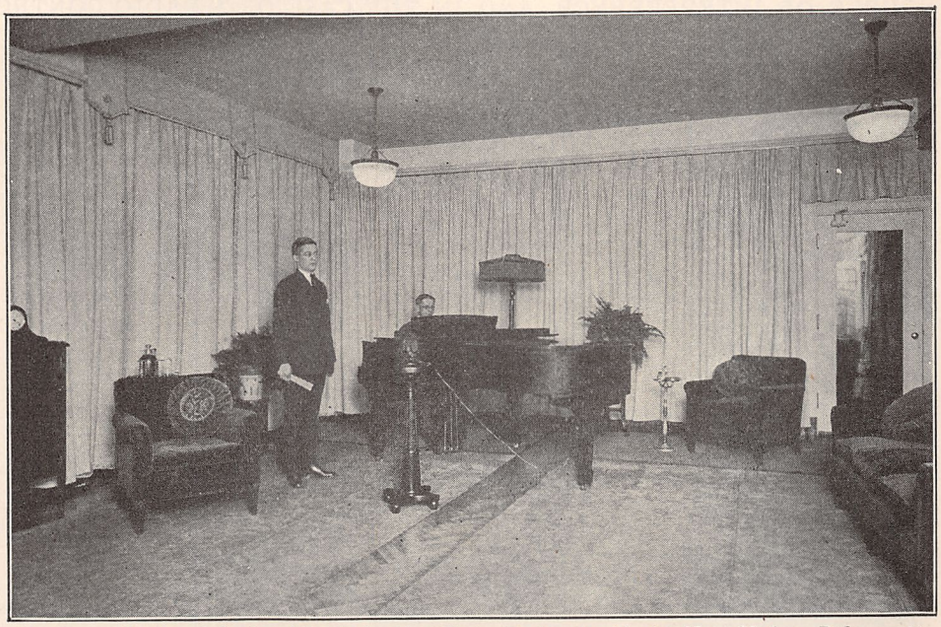
WEAF'S New Broadcasting Studios

By EDGAR H. FELIX

ON Monday, April 30, was placed in operation a most modern broadcasting studio, designed by the engineers of the American Telephone and Telegraph Company. It embodies all the lessons learned by six months of broadcasting from the Walker street studios of WEAF. Although these studios embodied all the latest practice of a year and a half ago, great improvements were made in acoustic qualities in the new studios which are located at 195 Broadway. From this point all broadcasting through WEAF, which is located at 463 West street, New York City, will be controlled.

Minute attention to detail is responsible for much of the improved acoustic qualities of the new studios. For instance, the floors are laid in pitch and mechanically insulated from the walls. In this way, none of the vibration transmitted to the floor, because the musical instruments are in contact with it, is passed to the walls and to the ceiling of the studio.

No studio can be ideal for every purpose unless the deadening is adjustable to suit the special means of the particular program being transmitted. WEAF's new studios have adjustable deadening curtains which can be easily changed between numbers of the program. A single speaker before the microphone requires but little deadening. If too much deadening is used the effect is apparent to the critical listener. A band, on the other hand, requires considerable deadening in order to avoid reverberation effects. All this can be taken care of by the studio director without delaying the program.



The Large Studio of Station WEAF in New York, Equipped with the Most Modern Refinements. A Smaller Studio Used at the Same Time Prevents Any Delay Between the Numbers of a Program, as Either of Them May Be Switched On.

To give an inviting and homelike appearance, the studio and reception rooms are comfortably yet simply furnished in Old English of the Georgian period. H. F. Huber and Company planned the decorations and furnishings. Particular attention was given by these specialists to acoustic effects which might create reverberation detrimental to the purity of broadcasting. Combining comfort and utility without sacrifice of acoustic properties required careful study of the problem.

(*Continued on page* 92)

New Alphabet for Radio and Land Lines

By General George O. Squier Washington D.C.

Sample of Tape Printed on the New Recorder. Note That Dots and Dashes Are of the Same Length But Vary in Height.

DUE to the rapid expansion of the use of radio telephony and telegraphy, the problem of interference, both natural and artificial, is becoming each day more and more pressing for solution. The conservation of the ether lanes is suddenly rising to international importance. In addition, the daily growing uses of radio for the solution of auxiliary problems such as range finding, navigation, beacons, etc., further serve to complicate the problem, and furthermore, it is believed that we are on the threshold of another development, viz., photo-broadcasting, which will require and demand additional ether channels to serve the public of the near future. It may be said, therefore, that the fundamental problem for the radio engineer is to devise methods to utilize these limited channels to the greatest extent possible, and to bend his efforts to the extension of their limits, both high and low.

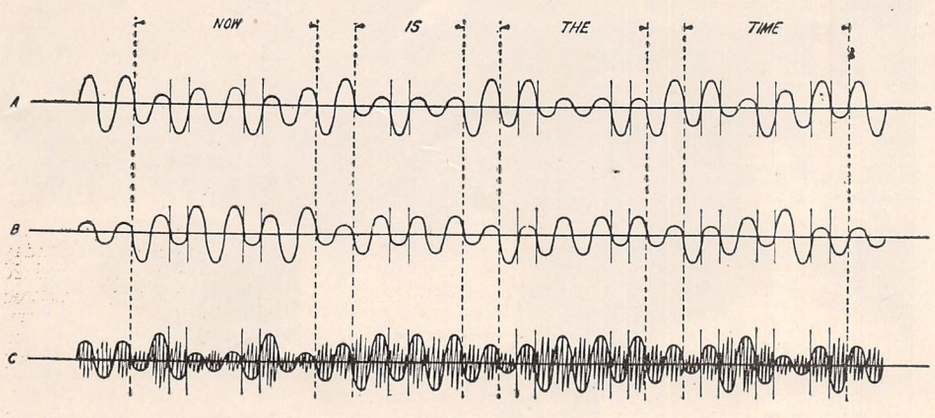


FIGURE 2.

Different Methods of Using Signal Corps Alphabet. In A the Dots Are Smallest in Amplitude, the Dashes Are Medium and the Spaces Are Largest, While in B the Spaces Are Smallest, the Dots Medium and the Dashes Largest. In C the Dashes Are Smallest, the Spaces Medium and the Dots Largest. There Are Three Other Possible Permutations of Amplitude Not Shown Here.

In the case of artificial disturbances the chief offender, from an engineering standpoint, is the radio telegraph practice as it is universally conducted at present. Radio telephony and music of all classes have a form of modulation which is scientifically more sound than that of telegraphy. It is impossible at present to tune out the high-power radio telegraph stations, especially when a receiving station is in close proximity. Such stations, as at present operated, produce a veritable eruption in the ether, creating disturbances over a wide range of frequencies, and these serve to interfere with any form of radio receiver yet devised. Who has not experienced this in the operation of his radio receiving set? Radio telegraphic transmission, therefore, demands new consideration and new study from a scientific standpoint.

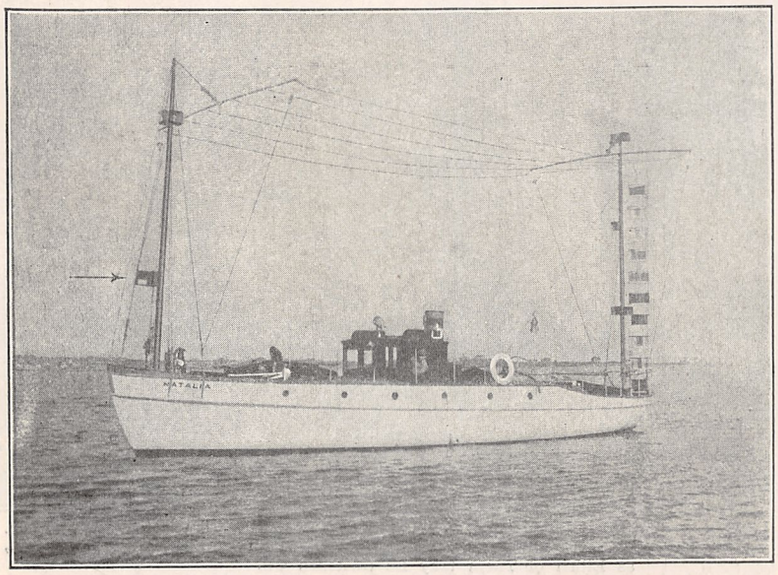
About eighty years ago Morse invented the telegraph alphabet of dots and dashes, and the modification of it, known as the International Morse, is now the universal method of international radio telegraphy. This method is believed to be fundamentally unscientific, and the time has come to thoroughly consider a radical revision of the method of sending telegraphic messages. I do not here refer to an actual change at present in the Morse alphabet as regards the combinations of dots, dashes and spaces assigned

(*Continued on page* 89)

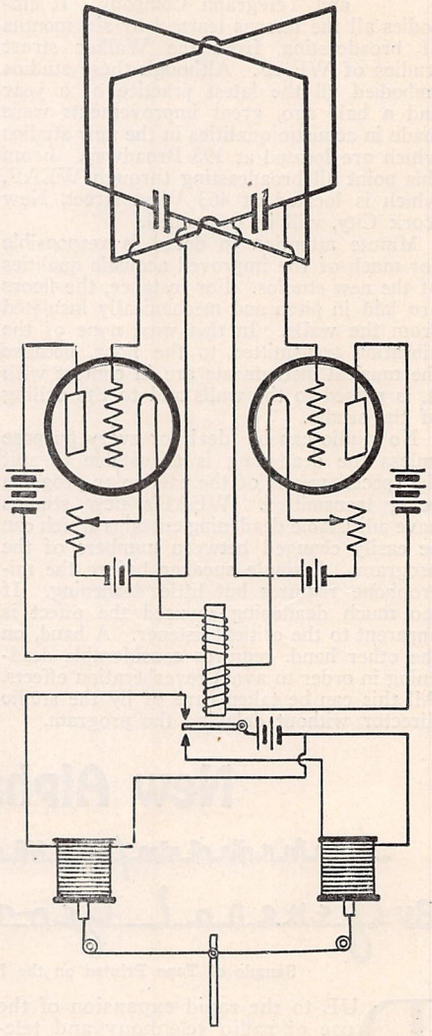
The Radio Stathmometer

THIS RADIO CONTROL APPARATUS CAUSES THE CRAFT EQUIPPED WITH IT TO RUSH TOWARD THE SOURCE OF INTERFERENCE, AND IN THE CASE OF A RADIO CONTROLLED TORPEDO TO DESTROY IT. IT IS ONE OF THE INVENTIONS OF

JOHN HAYS HAMMOND, Jr.



Left: John Hays Hammond, Jr.'s Yacht, the "Natalia," Which Is Equipped With a Radio Control System of the Type Described In This Article. Right: Fig. 2. Symbolic Representation of the "Radio Stathmometer" Circuit Arrangement.

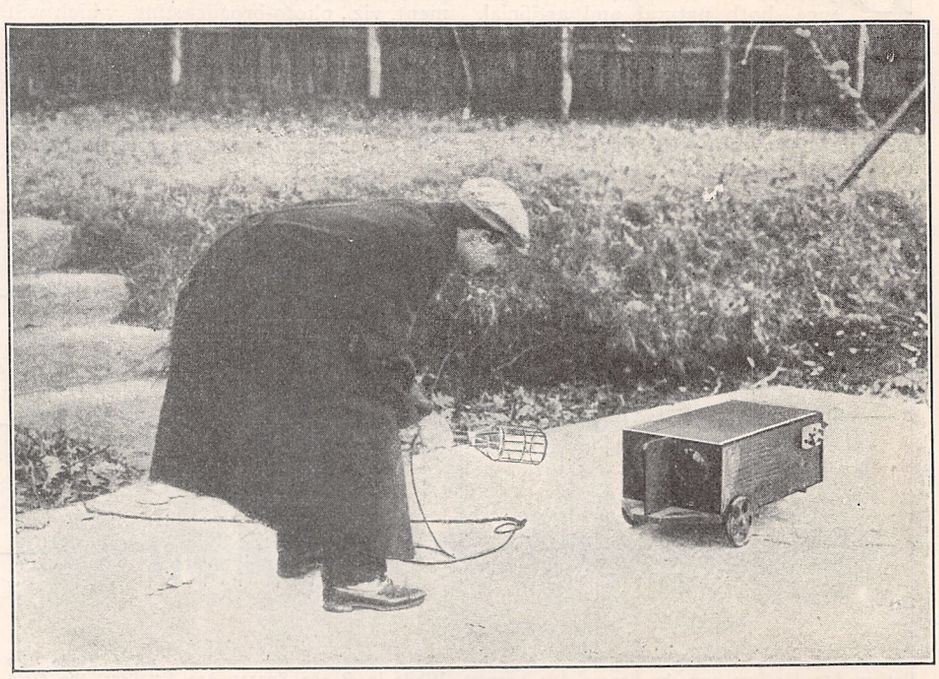


FOR a number of years John Hays Hammond, Jr., spent most of his time in the development of this most interesting subject, radio control, and has done much in bringing it to its present point. His patents on Radio Control systems and apparatus number more than 200 and cover practically every phase of the field as it is known today. Of more than usual interest is Mr. Hammond's Radio Stathmometer, which means mechanism that balances itself under the stimulation of radiant energy, whether this energy be light, heat or wireless waves. Most of the work on this machine was completed at least six or seven years ago, but this is the first information that has been given out regarding its purpose and means of operation. The object of the invention is to fulfill two purposes: To apply to radio controlled torpedoes, so that if intereference *at all* from the enemy were attempted, it would cause the torpedo to turn around and face the source of interference, and thereby destroy the ship that was creating the interference. This is one of the best answers to the idea of interfering with radio torpedo control, and will do much to discourage interference on the part of the enemy. The other object of the invention is, that when at night, lights from battleships are thrown on the torpedo or explosive carrier, it will turn around, face the beam of light and run up the beam towards the ship carrying the searchlight, and destroy it. Although these were the primary purposes in view when experiments were started, after leading up to the development of the present radio stathmometer, it is by no means the limit to which this machine can practically be applied. The principle of its operation can be incorporated in any type of moving machine, either on land or on water.

A photograph of Mr. Hammond's yacht, the *Natalia*, is shown above. This yacht was equipped with a radio-control system, on the principles of the Radio Stathmometer. A smaller model, or application of this principle, is shown in another photograph, on a mechanism which has popularly been called "the electric dog." John Hays Hammond, Jr., himself is shown in the picture, directing this mechanism by means of an electric light. In daylight, this machine will run around, following a 50-watt lamp. By reversing the current in the motor driving the mechanism it can be arranged so that the vehicle will always run away from the source of light.

THE MECHANISM

The orientation mechanism consists of a rectangular box, about 3′ long, 1½′ wide, and 1′ high. This box contains all the instruments and gears, and is mounted on three wheels, two of which are geared to a driving-motor, and the other, on the rear end, is so mounted that its bearings can be turned by the solenoid electro-magnets in a horizontal plane. Two 5″ condensing lenses on the forward end appear very much like large eyes. If a portable electric light, such as a hand-flash-light, be turned on in front of the machine, it will immediately begin to move toward the light and, moreover, will follow that light around the room, in many complex manoeuvers, at a speed of about 3′ per second. The smallest circle in which it will turn is about 10′ in diameter. This is due to the limiting motion of the steering wheel. Upon shading, or switching off the light, the dog can be stopped immediately, but it



John Hays Hammond, Jr., and His "Electric Dog." This Little Machine Will Follow a Light Around, Performing Many Complex Maneuvers. By Reversing the Current To the Motor It Can Be Arranged So That the Vehicle Will Always Back Away From a Source of Light.

will resume its course behind the moving light so long as the light reaches the condensing lenses in *sufficient intensity*. Indeed, it is more faithful in this respect than the proverbial "ass behind the bucket of oats." To the uninitiated, the performance of the pseudo dog is very uncanny indeed.

Referring to Fig. 1, the orientation mechanism here mentioned possesses two selenium cells, which, when influenced by light, effect the control of sensitive relays. The two relays controlled by selenium cells in turn control electro-magnet switches, which affect the following operations: When one cell, or both, are illuminated, the current is switched on to the driving motor. When one cell

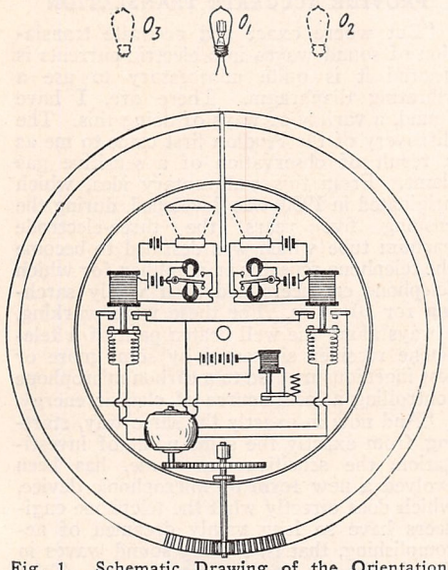


Fig. 1. Schematic Drawing of the Orientation Mechanism of the "Electric Dog." The Two Large Lenses In Front Focus the Light on Selenium Cells.

alone is illuminated, an electro-magnet is energized, and affects the turning of the rear wheel. The resultant turning of the machine will be such as to bring the shaded cell into the light. As soon and as long as both cells are equally illuminated in sufficient intensity, the machine moves in a straight line toward the light source. By throwing a switch which reverses the driving motors, the machine can be made to back away from the light in the most surprising manner. When the intensity of the illumination is so decreased by the increasing distance from the light source, that the resistances of the cells approach their dark resistances, which are comparatively high, the sensitive relays break their respective circuits, and the machine stops.

THE RADIO CONTROL SYSTEM

Another form of Radio Stathmometer is shown in the photograph of Fig. 3; this type is controlled by wireless waves. Two loop aerials, mounted at right angles to each other, replace the former selenium cells, or eyes of the electric dog. The energy collected by the loops from some controlling source is passed on to two vacuum tubes, which, in turn, actuate relays controlling the actions of the machine, in the same manner as described before. A better idea of this arrangement can be obtained by referring to the diagram of Fig. 2.

As the two loops are at right angles, it is evident that a controlling radiant energy, say at some angle to the right of the machine, would have an effect on but one of the loops. In other words, the second loop is shaded, so that in the case of radio waves transmitted from a point so as to hit or strike the end of but one loop, current would flow in the plate-filament circuit of but one of the vacuum tubes, thereby actuating the steering mechanism by means of the relay and solenoid electro-magnet, in a definite direction. This would tend to steer the machine towards the point from which the radio waves were being transmitted, until directly in line with them. Effects, then, would be equal on both of the loops, thereby equalizing the controlling effect of both relays, and the machine would move forward in a straight line. Any slight deviation of the radio waves, or accidental movement of the machine off this line, would produce a greater effect in one loop aerial than in the other, thereby again affecting the steering mechanism and bringing the machine back into line.

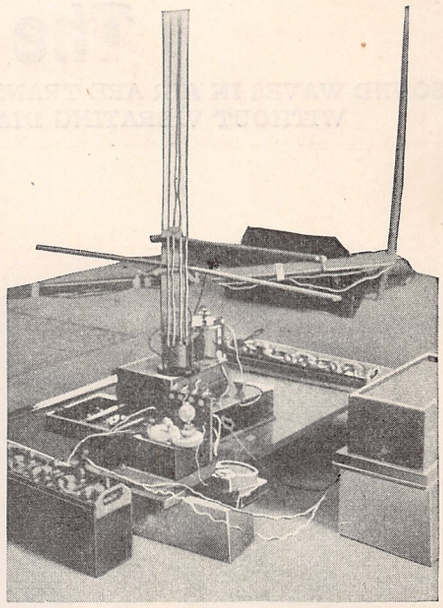


Fig. 3. A View of the Apparatus Composing An Experimental Model of a "Radio Stathmometer."

What Standardization Means to the Radio Buyer

By M. WOLF

THE layman buyer of radio has probably read in the radio section of newspapers and in radio periodicals that a conference was recently held in New York City to consider the subject of standardizing radio apparatus. The conference was initiated by the Bureau of Standards and attended by various radio organizations and representatives of dealers, manufacturers, associations and so on. It will be of undoubted interest to the layman to know what this business of standardization means, the cause and need for it.

Before the general public interested itself in radio, manufacturers and dealers catered to a very small crowd. This crowd was, generally speaking, on quite intimate terms with matters radio and was quite proficient in the technical details of the subject. Amateurs, professionals, and the technical schools were the patrons and customers of the radio business. When these people went out to buy apparatus they knew what they wanted and knew how to ask for it. The manufacturers and dealers, therefore, had to be able to talk their particular jargon. Errors were relatively few on account of this mutual understanding. Thus when an amateur wanted a condenser, say for transmitting, he knew what its capacity rating should be, he knew what maximum voltage it had to withstand, how much current it had to be able to carry and so on. The manufacturer and dealer had to be able to fill the bill with a condenser of the required specifications.

Just a little over a year ago THE radio boom took place and it had all the earmarks of a veritable Klondike. To people in and out of the business it looked like a gold mine. As a result there was a mad rush of people into the business. The butcher, the baker, the candlestick maker all set up as radio men of one sort or another. Some manufactured, some wholesaled, some retailed, and some, be it noted, engineered. Apparatus of all descriptions were turned out, good, bad and indifferent. And most of the apparatus was, in fact had to be, modelled after existing patterns made by the older manufacturers. Apparatus was turned out with a certain name attached to it and had to be bought that way. Thus a man bought a "variometer," regardless of its constants. A man bought a condenser with so many plates, but did not know its capacity. Rheostats were built and bought for a certain vacuum tube, but it had no resistance specifications. In the same way receiving sets, headphones, couplers, coils and so on were built and sold on the name of the apparatus regardless of its specifications.

DEMAND EXCEEDED THE SUPPLY

This condition was made possible only by the fact that the demand for merchandise was unprecedented and particularly by the fact that the layman buying radio goods was as yet unfamiliar with the terminology, with what to ask for; he did not know, as a matter of fact, exactly what he wanted. So he bought "variometers," 3000-ohm headphones, 23-plate condensers, and all other equipment. He bought them blind, practically, and relied upon the dealer or manufacturer to give him the right stuff.

In short, there was nothing standardized about radio apparatus. Each manufacturer made his own apparatus in his own way, but nothing was known about the apparatus, excepting its name. A "variometer" was a "variometer," regardless of who made it, although as a matter of fact each variometer may be very different from the next. A variable condenser was designated by the number of plates, thus 23-plate condenser, although the size and spacing of the plates may have been different for the various makes of condensers.

The situation could be compared to a hypothetical situation such as the following: Suppose electrical manufacturers sold just a "D. C. Motor" or a "Wattmeter" without giving specifications. It would be identical to selling a "variometer" without any further specifications, or a 23-plate condenser. However, the electrical industry has been standardized so that all electrical apparatus must have definite specifications. Thus an electric motor is specified by its power, its voltage, current, speed, what type of current it carries, as A.C. or D.C., so that when a man buys an electric motor he knows what to expect of it and what it will do. But when a man buys a variometer he generally does not know what its range of inductance is, or what its resistance or distributed capacity is.

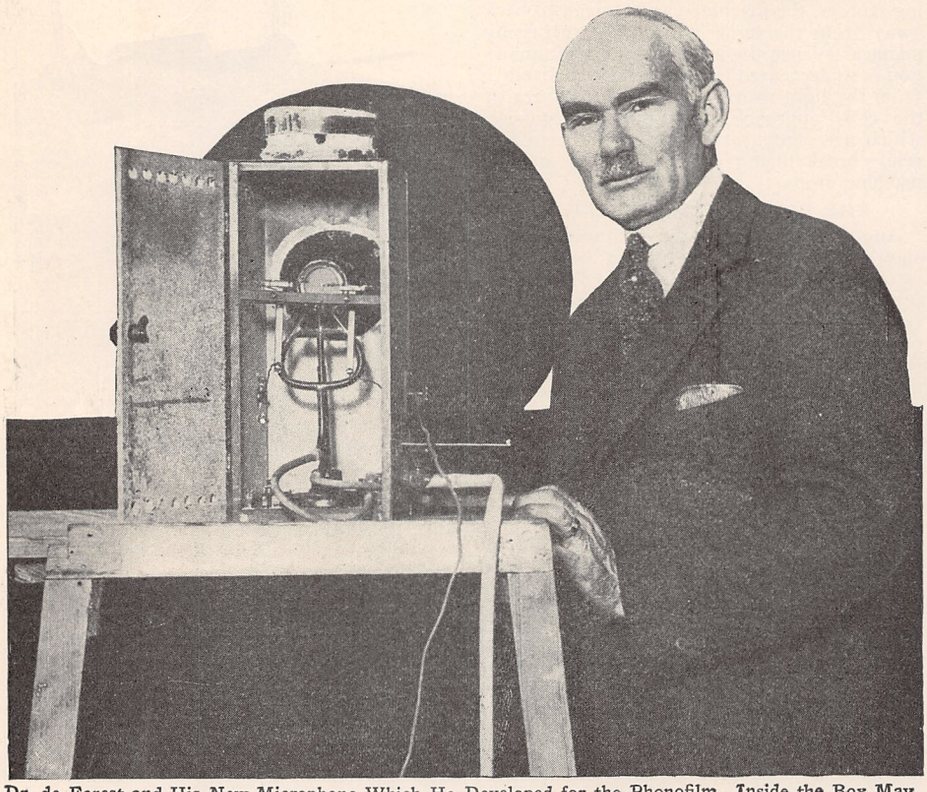
The object of a standardization movement is to have manufacturers and dealers furnish specifications with each piece of apparatus they sell, so that the buyer will

(*Continued on page* 103)

The Flame Microphone

SOUND WAVES IN AIR ARE TRANSLATED DIRECTLY INTO ELECTRICAL ENERGY THROUGH A FLAME, WITHOUT VIBRATING DIAPHRAGM. IT IS THE RESULT OF PHONOFILM DEVELOPMENT.

By DR. LEE de FOREST



Dr. de Forest and His New Microphone Which He Developed for the Phonofilm. Inside the Box May Be Seen the Burner and Electrodes.

FOLLOWING the cordial public reception given to the invention of the de Forest Phonofilm or talking motion picture which was formally given a demonstration before the members of the New York Electrical Society in the Auditorium of the Engineering Societies Building, Dr. Lee de Forest announces that he has realized the dream long held by telephone engineers, namely, the translating of sound waves in the air directly into electrical currents, thereby eliminating the vibrating diaphragm.

An entirely new form of microphonic device has been evolved by the inventor, in part as a result of his development of the Phonofilm, a speaking flame, if you please, which gives promise of revolutionizing the present methods of transmitting voice sound waves into electrical waves and without the distortion associated with the older methods of voice transmission. The field of immediate application of the talking flame device is not only in the province of the talking motion picture film, but in the world of radio as well, and especially in those stations used for broadcasting the human voice to the millions of radio listeners throughout the country.

DIRECT TRANSFORMATION OF SOUND INTO ELECTRICAL ENERGY

"In response to the numberless inquiries of scientists, educators, engineers and others directly interested in the development of the talking motion picture art," says Dr. de Forest in a statement issued by the de Forest Laboratories, "I should like to take this occasion to announce that as a result of my development of the new Phonofilm my investigations and experiments have resulted in revealing what I consider will be another revolutionary step forward in the transmission of the human voice or sound through space. The advance itself may be regarded as a technical one from the engineering point of view, and yet from the benefits to be derived from the world at large the improvement is somewhat marvelous in that by means of it hereafter we shall be enabled to change voice or sound waves directly into electrical energy.

NO DIAPHRAGM USED

"It has for a long time been realized by telephone and acoustic engineers that the necessity for a diaphragm at the transmitter introduces at the very outset of the sound translation problem a source of distortion and imperfection. It is the diaphragm more than any one element which introduces the deformation in recording and in reproducing voice and music on the phonograph as well as in telephone transmission. Therefore for many years efforts of telephone and phonograph engineers have been devoted to reducing as far as possible distortions thus introduced by the natural period of vibration of the diaphragm, or membrane, against which the sound waves impinge. But these engineers have not looked elsewhere in the realm of physics with sufficient scrutiny. Otherwise we should long ago have been free of the necessity for using any diaphragm whatsoever at the transmitter element of apparatus, the object of which is to translate sound into electric currents with the minimum possible distortion, regardless of the expense of the elaborateness of the apparatus thereby involved. I do not here refer to the ordinary microphone transmitter, millions of which are in use throughout the world, and which must necessarily be as simple and cheap as possible. For such telephone apparatus the carbon microphone with diaphragm may possibly always be used.

PROVIDE ACCURATE TRANSLATION

"But where exact and accurate translation of sound waves into electric currents is desired it is quite unnecessary to use a vibrating diaphragm. There are, I have found, a variety of ways of doing this. The discovery of the Audion first came to me as a result of observation of a sensitive gas flame. From this rudimentary idea, which originated in 1900, was developed, during the ensuing five years, the three-electrode vacuum tube which was destined to become the telephone repeater or amplifier for which telephone engineers had been vainly sarching for 20 years. For these were working, always along the well beaten path of a telephone receiver siameesed by some more or less ingenious method to a carbon microphone controlling a local source of electric energy.

"And now in exactly the same way, starting from exactly the same point of investigation, the sensitive gas flame, has been evolved a new form of microphonic device, which does directly what the telephone engineers have so long vainly dreamed of accomplishing, that is, turning sound waves in the air directly into electric currents. Take the ordinary bat-wing gas burner or a certain form of Welsbach mental gas light, or special forms of oxy-acetylene gas flames, insert two heat-resisting electrodes therein, in proper relation to the flame and to each other, connect these electrodes to an appropriate electro-motive force. You will then have an extremely sensitive sound converter which gives an electric reproduction of the sound waves in the air enveloping the flame which is of an entirely different order of fidelity from that ever obtained from any form of microphonic device, using a diaphragm, whether this be of the carbon, electro-magnetic, or electro-static variety.

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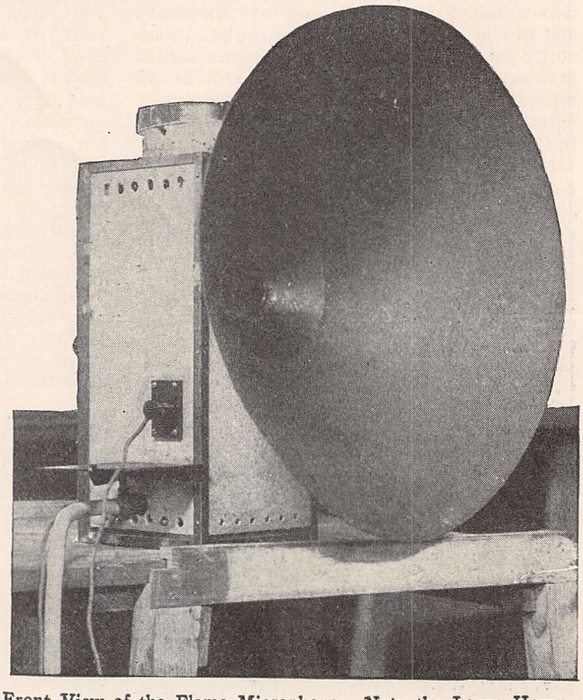


Front View of the Flame Microphone. Note the Large Horn; This Concentrates the Sound on the Flame.

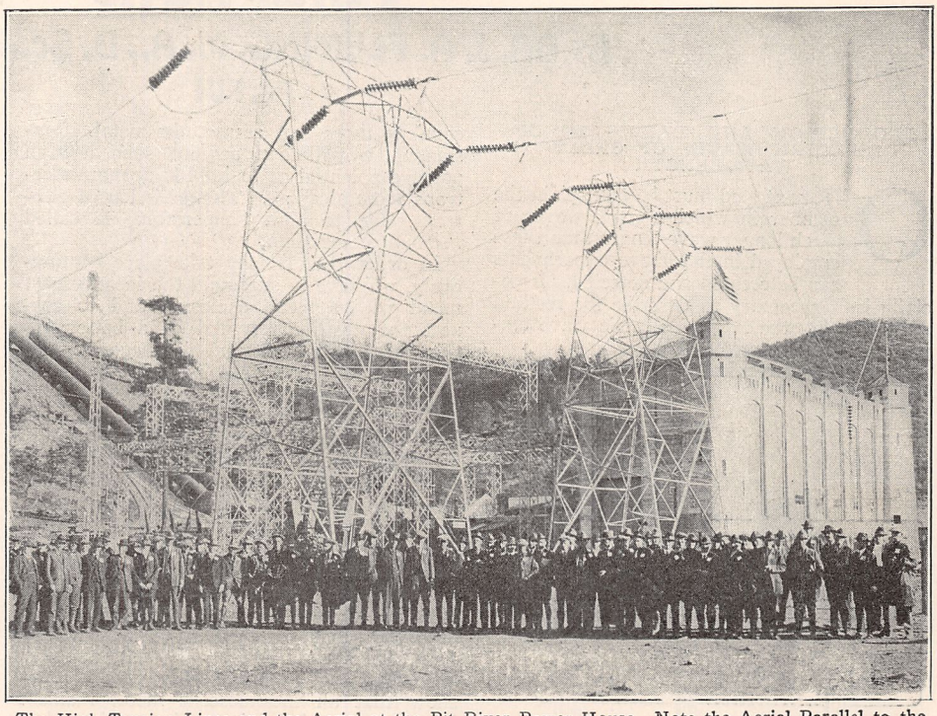
The World's Longest Line Radio System

By CHARLES W. GEIGER

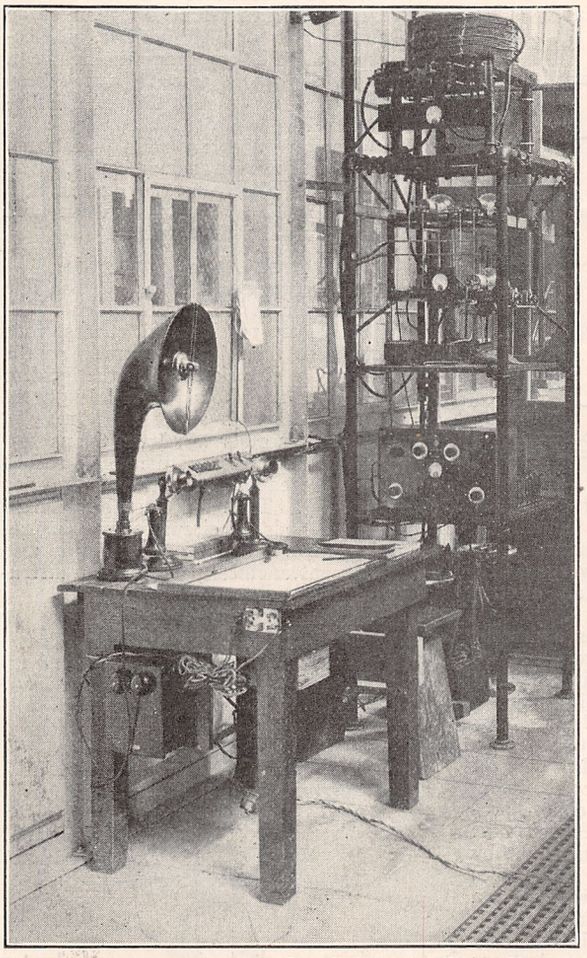
THE Pacific Gas & Electric Co. now has in successful operation the world's longest guided radio telephone and telegraph system between the Vaca-Dixon substation and the Pit River Power House No. 1. The system utilizes the twin circuit 220,000-volt transmission lines between the two points for a conducting medium, a total distance of 202 miles, and is for the sole purpose of directing the operation of the two stations both under normal and emergency conditions.

The system is coupled to the transmission line through a single wire antenna about 1800′ long. This wire is attached to the twin vertical circuit transmission towers at a point on the center line of the tower and at the elevation of the middle cross arm. Six standard 10″ suspension insulator units are used for dead ending and supporting the antenna. The main station ground system is also used as a ground for the radio equipment, sending on a wave-length of about 10,000 meters.

The transmitting equipment is a regular vacuum tube Radiophone similar to those used by the high power broadcasting stations. Four 250-watt and one 50-watt Radiotron tubes are employed, two of the tubes being used as oscillators and two as modulators with the 50-watt tube as a speech amplifier. The plates of the 250-watt tubes are supplied with a potential of 2,000 volts D.C. from a 2-kw. generator. This generator has two commutators, each supplying 1,000 volts D. C. and a tap is taken off to supply 1,000 volts D.C. potential to the plate of the 50-watt tube. Mounted on the same shaft with the 2000-volt generator is a 1⅜-kw., 125-volt exciter which also has sliprings for supplying 88 volts, 30-cycle alternating current. This 88-volt alternating current is stepped down to 11 volts through a special 800-watt transformer and is used for lighting the filaments of all the tubes. The generator and exciter are driven by a direct connected 6¾-hp., 115-volt D.C. shunt-wound motor. This motor derives its energy from the main station storage battery which is unusually large in order to handle the 220,000-volt oil circuit breakers. Normally the battery floats on the charging set and a contactor has been installed in connection with the automatic motor starter which short circuits a portion of the charging generator field rheostat and permits a rise in generator voltage to compensate for the extra load of the radio motor generator set. Thus under normal conditions of operation no drain is placed on the storage battery. An automatic motor starter is used for control of the motor-generator set, the starting and stopping of the set being accomplished by taking the telephone receiver off or putting it on the hook.



The High Tension Lines and the Aerial at the Pit River Power House. Note the Aerial Parallel to the Lines and the Lead in on the Right. A Wave-Length of 10,000 Meters is Employed in This Wired Radio System.



The Transmitter and Receiver Installed in the Power House. Note the Calling System Consisting of a Microphone Attached in the Horn of the Loud Speaker Which Howls When the Other Station Rings.

The receiving equipment consists of a Colin B. Kennedy type 110 Universal receiver, which has been modified to make it a non-regenerative receiver, and a Western Electric loud speaking outfit using two stages of audio-frequency amplification.

Calling is accomplished by mounting a calling microphone in the horn of the loud-speaker which, when the calling circuit is completed, will oscillate and howl in much the same manner that the ordinary telephone will howl when the receiver is placed against the transmitter. This gives a very loud note, the pitch of which will depend upon the natural period of oscillation of the diaphragms and which is clearly audible in all parts of the station. Ordinarily, it is not necessary to use the calling system, as the receivers are always in service and the operator is near the set so that the loud speaker simply talks to him and he starts up his set and talks back. The system is arranged for simplex operation and all that is necessary is to operate a small telephone switch which energizes a contactor to connect either the transmitting or receiving set to the antenna, thus permitting talking or listening.

All the experimenting and development work necessary to place the equipment in a satisfactory operating condition was done under the direction and supervision of Dr. L. F. Fuller.

The accompanying photos show the temporary equipment during the experimental stage at Pit River Power Plant No. 1.

USE OF KILOCYCLES IN RADIO

The Second National Radio Conference, which met with Secretary Hoover in March, introduced a method of designating radio waves which is somewhat new to the radio public. This is the use of frequency in kilocycles (abbreviated kc) instead of wave-length in meters. The advantages of this practice have been familiar to radio engineers for some time, and it is probable that it will eventually replace the use of wave-length in meters. As a matter of fact, wave-length is a somewhat artificial conception in the handling of radio apparatus and is one of the difficult things for the beginner to understand. The frequency of the radio

(*Continued on page* 82)

Electrons, Electric Waves and Wireless Telephony

By DR. J. A. FLEMING, M. A., D. Sc., F. R. S.

Part VI

PRODUCTION AND DETECTION OF ELECTRIC WAVES OF GREAT WAVE-LENGTH

OUR next step must be to explain the manner in which electric waves of much longer wave-length than those employed in the above experiments can be created and detected. Especially is it necessary to describe the method of generating the type of electric wave employed in wireless telephony.

It will be convenient to begin with a description and explanation of an instrument called a thermionic valve, because this is used not only to create but to detect these electric waves of great wave-length.

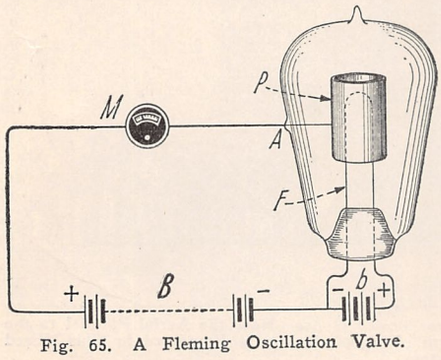


Fig. 65. A Fleming Oscillation Valve.

It has been mentioned already in speaking of the free electrons in conducting materials that these atoms of electricity are in constant irregular motion in the inter-atomic spaces. Part at any rate of the sensible heat contained in any substance which gives it what we call its temperature, is due to the energy of motion of these free electrons.

According to a certain theory called the theory of equipartition of energy, these free electrons should have the same average kinetic energy as gas atoms would have at the same temperature. We have seen that the root mean square (R.M.S.) value of the velocity of molecules of oxygen gas is nearly 461 meters per second, and since the atom of oxygen is 16 times heavier than the atom of hydrogen, the R.M.S. velocity of hydrogen molecules is $\sqrt{16} \times 461 = 1844$ meters per second. But a negative electron has a mass of about 1/1,700th of that of a hydrogen atom. Hence the R.M.S. velocity of the free electrons in a conductor should be $\sqrt{1700} \times 1844 = 41 \times 1844 = 75{,}604$ meters per second, or nearly 47 miles per second.

ELECTRONS FLY FROM FILAMENT

If the temperature of the conductor is raised this electronic velocity will be increased, being nearly proportional to the square root of the absolute temperature; that is, the temperature reckoned from—273° centigrade. If then the temperature is very high, the velocity of some of the free electrons may become so great that those near the surface of the material are flung off from it.

This, indeed, is what happens when a wire, say, of tungsten is heated to a bright incandescence in a high vacuum, as in the case of the filament of an incandescent electric lamp. It must be remembered, however, that every electron which escapes leaves behind it a chemical atom deprived of an electron, and therefore having a positive electric charge of equal amount. Hence unless we supply from some source electrons equal to those that escape, the metal, if insulated, would soon acquire such a high positive potential as to hold back more electrons from escaping. This emission of electrons, due to high temperature, is called *thermionic emission*.

In order that it may take place continuously, we have to surround the incandescent metal with a metal enclosure and to connect the positive terminal of a battery to this sheath or plate, and the negative pole to the hot filament (see Fig. 65).

THE ROLE OF THE PLATE

The arrangement then that is necessary is to construct an ordinary high vacuum incandescent electric lamp, having a straight or loop filament (F), preferably made of drawn tungsten wire, because that material has a very high melting point and will bear heating to 2,000° C. or 2,500° C. without risk of fusion (see Fig. 61).

Around this filament but not touching it, is a metal cylinder (P), made of sheet nickel, which is fastened to a platinum wire (A), sealed airtight through the glass bulb. With such an appliance it is very easy to show that an incandescent metal filament in a vacuum is giving off negative electricity by the following experiment (see Fig. 65).

Provide a gold leaf electroscope, consisting of a pair of gold leaf slips contained in a glass bell jar. Connect the terminal of this with the metal cylinder of a valve. Give to the gold leaves and metal cylinder

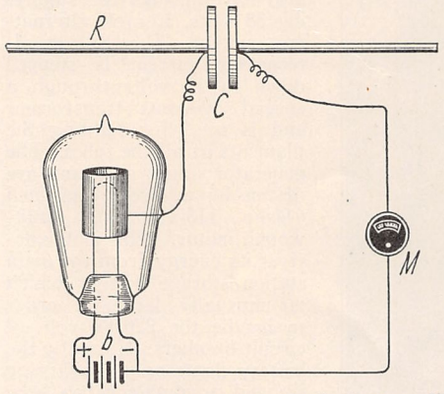


Fig. 66. R, Rod Resonator. C, Condenser. V, V, Oscillation Valve. M, Galvanometer or Milli-Ammeter.

a charge of negative electricity by means of an ebonite rod, rubbed with flannel. If the filament of the valve is not incandescent the gold leaves should remain diverged, that is, the system should retain an electric charge of negative electrons.

If then we make the filament incandescent by passing an electric current through it, we shall find that the negative charge is still retained by the cylinder and gold leaves.

If, however, we give them a charge of positive electricity by means of a warm glass rod rubbed with silk, the filament being cold or not incandescent, we shall find that the system still retains that charge provided the insulation is good. The moment that the filament is made incandescent by passing a current through it, the gold leaves of the electroscope collapse, showing that a charge of positive electricity is instantly removed from the cylinder. This can only be due to the emission of negative electrons from the incandescent filament. It is convenient to make the filament of such a length that it is rendered incandescent by the current from a storage battery of two to six cells or, say, 4 to 12 volts.

If then we connect the positive pole of another separate voltaic battery to the terminal of the metal cylinder, technically termed the plate, and the negative pole to the negative terminal of the filament, and if we insert in that circuit an instrument called a milliammeter, for detecting and measuring electric currents, we find a current, that is a stream of electrons moving, inside the bulb from the hot filament to the metal cylinder. This is called the *thermionic current*.

Since the stream can only flow when the cylinder is positively electrified and the filament negatively electrified, because the filament can only emit negative electrons, the device enables us to permit electrons to move in a circuit only in one direction. Hence it was named by the author in 1904, who so used it for the first time, an *oscillation valve*, and it is now commonly called a *Thermionic valve*.

The great use of it proved to be to convert high frequency alternating currents of electricity into unidirectional or direct currents. If in place of the battery we connect the plate of the valve with the filament through a circuit outside the valve which contains some source of alternating electromotive force or high frequency oscillations, then it will be evident that when the electromotive force is in such a direction as to make the cylinder or plate positive, an electron current will flow from the filament, but when the plate is negative it will keep the electrons from coming out of the filament. Therefore the electron current is always in one direction through this external circuit or plate circuit as it is called. The high frequency alternating current is then said to be *rectified* by the valve, when used as follows:

THE VALVE AS A DETECTOR

Let there be two metal rods placed in line with each other in a region through which electric waves are passing, and let these rods be placed with their lengths parallel to the direction of the electric force in the incident waves and let their total overall length be adjusted so that it is about 2¼ times the wave-length. In other words, let the natural frequency of oscillation of the whole rod be adjusted to be equal to the wave frequency (see Fig. 66). Then let these be inserted between the rods, a circuit comprising an oscillation valve as above described, and also a sensitive galvanometer, which is an instru-

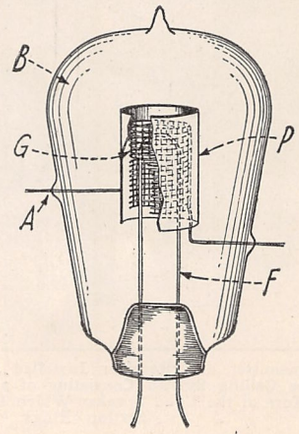


Fig. 67. A Three-Electrode Thermionic Valve.

ment for detecting a direct electric current. If then an electric wave falls on the receiving rods it will create electric oscillations in them, but the thermionic valve will only allow the currents in one direction to pass and to affect the galvanometer.

If the electric waves are produced by spark discharges in a transmitter, as explained in a previous section, then these waves and the oscillations they produce in the receiving rods come in little groups with intervals of silence. These are called *damped trains of oscillations*. When rectified by a Fleming valve they are then converted into little gushes of electricity, all in one direction, which come at intervals of time equal to the intervals between the spark discharges.

THE TELEPHONE RECEIVER

A telephone does not permit the passage of a high frequency current through it, but it is caused to emit sound if an interrupted direct current is sent through it, having the frequency of the interruptions between, say, 100 and 10,000. Accordingly, on listening to the telephone receiver when it is joined in series with the plate circuit of a thermionic valve, in which a series of damped electric oscillations are being created, we hear a musical sound as long as the groups of oscillations continue. The frequency of this sound is the same as the frequency of the groups of oscillations, that is, of the sparks creating them.

An improvement on the original single cylinder or two-electrode valve was effected by the interposition of another cylinder of metal gauze, or a spiral of metal wire between the filament and the cylinder of solid metal. This gauze or spiral cylinder is technically termed a *grid*, and a thermionic valve with a cylinder (plate) and grid is called a three-electrode valve (see Fig. 67).

This triple-electrode valve is remarkable for the astonishing number of ways in which it may be used to detect as well as create electric oscillations. We shall first briefly describe its use as a detector of feeble damped electric oscillations, which come in groups or trains.

For this purpose we connect the negative terminal of a voltaic battery *B*, say, of 40 or 50 cells to one terminal of the filament of a valve, which we shall assume has a filament rendered incandescent by a small separate battery *b* of three cells (see Fig. 68). The latter is called the filament heating battery, and the former the plate battery. This last has its positive terminal connected to the cylinder or plate of the valve and the circuits of a receiving telephone receiver *T* are included in this circuit; the terminals of the telephone are usually also connected to the plates of a small condenser.

In the next place the grid is connected to one terminal of a small condenser *c*, called the grid condenser, and this condenser has its terminals also connected by a very high resistance *l*, called the grid leak, which often consists of a piece of ebonite on which has been rubbed some plumbago or so-called black lead.

The second terminal of the condenser is connected through one coil of an induction coil with the filament of the valve, the other circuit of this induction coil being included in the circuit in which oscillations are generated by the electric waves to be detected. On the other hand the filament of the valve and one terminal of the grid condenser can be connected to the receiving aerial wire as shown in Fig. 64.

The operation then is as follows: When electric waves fall on the receiving or aerial wire they create in it oscillations, and these in turn charge the receiving condenser in one direction or the opposite, and this causes the grid to be charged with electricity either positive or negative. Again the battery in the plate circuit is causing a stream of electrons to issue from the filament, and these make their way to the plate by passing through the interstices or holes in the grid.

If the grid is negatively electrified, which means if there are negative electrons on it, then, owing to the mutual repulsion of electrons of like kind, these prevent the electrons from the filament from passing through the grid to reach the plate. If, however, the grid becomes positively electrified by the oscillations from the aerial, then the negative electrons from the filament neutralize that positive charge. Hence the effect of the oscillations in the receiving wires is to cause the plate-current or flow of electrons from the filament to be reduced, and therefore to check the current through the telephone. It is then necessary to provide a means by which the negative charge on the grid can be continually removed. This is achieved by the grid leak, which is a very high resistance of several million ohms put across the terminals of the grid condenser. This leak brings the grid back to a neutral condition between the arrival of each group of waves. If then these waves are produced by a spark transmitter of the Hertzian type, the impact of each group on the receiving wire causes a sudden decrease in the thermionic current flowing through the telephone, and this, as explained in the next section, causes the telephone to emit a sharp brief sound. If then the groups of waves continue to arrive, these sounds run together into a musical note of the same frequency as the spark of the discharger. By making these sparks endure for various periods of time, short or longer in accordance with a certain code of alphabetic signals, the auditor listening in at the receiving telephone will hear sounds of corresponding duration and can spell out the letters received.

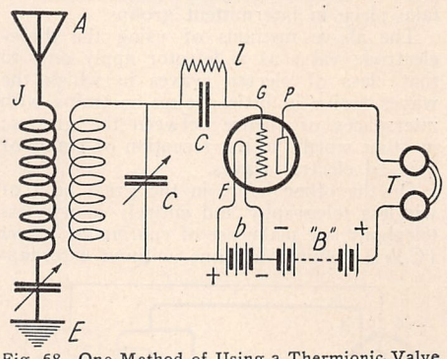


Fig. 68. One Method of Using a Thermionic Valve, to Detect Damped Electric Oscillations, Set Up in the Aerial "A."

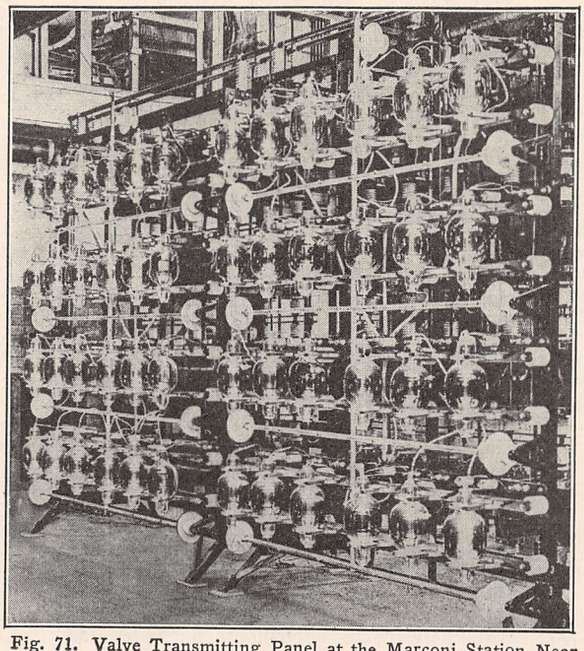


Fig. 71. Valve Transmitting Panel at the Marconi Station Near Carnarvon.

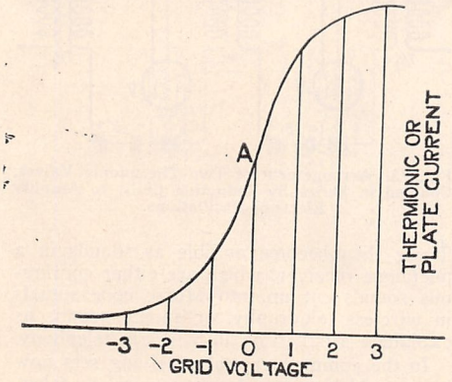


Fig. 69. A Characteristic Curve of a Three-Electrode Thermionic Valve.

Before we can discuss other methods of employing this triple electrode valve for detecting feeble electric oscillations it will be necessary to explain briefly the nature of its *characteristic curve*.

We insert in the external plate circuit of a thermionic valve a battery with negative pole connected to the filament and an instrument called a milliammeter for measuring small electric currents by the deflection of an indicating needle over a divided scale. These currents are conveniently measured in terms of a unit called a milliampere, which is one thousandth part of an ampere, or about one-tenth of the current through an ordinary 200-volt incandescent lamp.

We then make arrangements for giving to the grid a positive or negative potential by means of a battery of varying number of cells.

THE EFFECT OF GRID VOLTAGE

Let us begin with the grid in a neutral or unelectrified condition, viz., at zero potential.

The thermionic current or flow of electrons from the filament has then a certain strength, called the normal strength, when reckoned in milliamperes. This current of negative electrons flows from the filament, through the grid to the plate or cylinder of the valve, and then back through the external circuit and the milliammeters to the filament. We can represent this current by the length of a vertical line *OA* drawn perpendicularly to a horizontal line on which we mark off lengths proportional to the voltage of the grid (see Fig. 69). If then we make the grid slightly negative, say by 1, 2, 3, volts, etc., we shall find that the plate or thermionic current gradually decreases and this may be represented by lines of decreasing height drawn at equal intervals of distance to the left of the central normal line. If we make the grid positive by 1, 2, 3 volts respectively, we find that the plate current increases, but not indefinitely. It reaches soon a maximum value which cannot be exceeded. The plate current is then said to be *saturated*. If we join the tops of the vertical lines denoting the plate currents we obtain a curve called the plate-grid *characteristic curve* of the valve.

We see, therefore, that if we give the grid a certain positive voltage corresponding to the point at which the curve just begins to bend over, and if we superimpose on this steady voltage an alternating high frequency voltage due to an oscillation, the plate current cannot be much increased when the latter voltage is positive, but it is decreased

when the alternating voltage becomes negative.

Hence the superposition of an alternating voltage on the grid then always decreases the plate current and causes a telephone in that circuit to emit a sound which is a musical or continuous sound if the oscillations take place in intermittent groups.

The above methods of using the three-electrode valve as a detector apply only to that class of electric waves in which the waves arrive in little groups or trains with interspaces of silence between the groups; in other words, to the reception of trains of damped electric waves.

On the other hand, in the great bulk of wireless telegraphy and entirely in wireless telephony, we make use of *continuous waves* (C.W.), which continue without interruption except in so far as they are deliberately interrupted or varied in amplitude to make the signals or speech sounds.

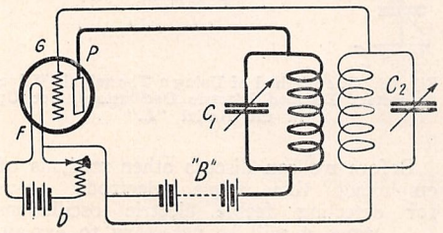


Fig. 70. Method of Using a Thermionic Valve to Create Undamped Electric Oscillations. P, Plate of Valve. G, Grid. F, Filament. B, Plate Battery. b, Filament Battery.

HOW THE VALVE OSCILLATES

It has been explained that if the grid potential varies from positive to negative by removing from or adding to it excess electrons, the plate current or stream of electrons from the filament will also vary, increasing when the grid is positive and decreasing when it is negative.

Hence if we cause the grid to alternate in potential it will make the plate current also fluctuate in such fashion as to be equivalent to the superposition of an alternating current on a direct current.

If we insert in the plate circuit the primary coil of an induction coil, then the terminals of its secondary circuit will provide an alternating voltage which exactly imitates in wave form the alternating potential of the grid, but can be made to have much greater amplitude.

A little thought will make it evident that if we couple back the terminals of the secondary circuit of this induction coil respectively to the grid and the filament in the right direction, we can cause variations in the plate current to give the grid the proper alternating voltage to sustain those variations in the plate current, so that the apparatus continues to operate to produce high frequency continuous oscillations in the plate circuit.

We have it in our power to control the frequency of these oscillations by putting condensers C_1, C_2, of suitable capacity across the terminals of the primary and secondary circuits of the induction coil, these circuits being tuned to the same frequency (see Fig. 70).

We are able therefore to use the valve as a generator of undamped oscillations and it has the property of creating electric oscillations, the wave form of which is exactly a simple periodic curve like the sound wave form of a tuning fork or open organ pipe gently blown. Moreover, we can harness together a number of these generator valves so as to employ a battery of them to create very large oscillatory currents of any required frequency and simple or pure wave form.

Generator valves are now made for this purpose, which have glass or silica bulbs about the size of a football, and 50 or 60 of these valves can be arranged on panels to create very large high frequency currents.

The illustration Fig. 71 shows such a large valve panel as is used in the great Marconi Wireless Telegraph station near Carnarvon, on the flank of Snowdon, for world-wide wireless telegraphy.

Another discovery of great practical value in connection with this subject was that if the grid and the plate circuit are coupled together inductively, as above described, but if the primary and secondary circuits in the plate and grid circuits respectively are placed so far apart that they are just, but not quite, on the point of generating self-sustained oscillations, the system becomes very sensitive to the effect of any additional electric impulses produced by incident electric waves. The valve is put into a condition in which it is just on the point of self-oscillation and the effect of the feeblest waves of the frequency for which its circuits are tuned will then be to create oscillations as long as the waves are arriving. This is called *regenerative coupling.*

We shall discuss its special application in connection with wireless telephony in a later section. Meanwhile it is important to notice that the thermionic valve has an exceedingly valuable use as an *amplifier* of oscillations of high or low frequency.

We have pointed out that any variations in the electric potential of the grid are accompanied by corresponding variations in the plate current.

THE VALVE AS AN AMPLIFIER

Suppose we insert in the plate circuit one coil of a transformer consisting of two insulated wires, one superimposed on the other, the two wires being wound on one bobbin or tube. In addition, we insert in the plate circuit a battery B with its positive pole connected to the plate and its negative pole to the filament (see Fig. 72).

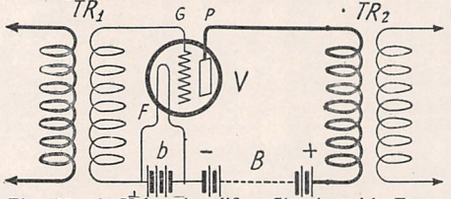


Fig. 72. A Valve Amplifier Circuit, with Transformer Couplings.

If now we apply to the grid a feeble alternating electromotive force, this will make the grid alternately positive and negative in potential. This will, as above explained, cause the plate current to fluctuate, and this current passing through the primary coil of the transformer T_2 will create a secondary electromotive force in the adjacent coil which can be made by suitable proportioning of the circuits to have the same frequency, but much greater amplitude than the electromotive force (E.M.F.) applied to the grid. It may in fact have an amplitude of 5 or 10 times as great. Thus if the E.M.F. applied to the grid varies from $+1$ volt to -1 volt, and has therefore an R.M.S. value of about 0.707 volt, the E.M.F. on the secondary terminals of the plate transformer may have an R.M.S. value of 5 or 10 times greater.

The thermionic valve is then said to amplify voltage 5 or 10 times.

It is then obvious that we can apply this amplified E.M.F. to cause fluctuations in the potential of the grid of a second valve similarly equipped with a transformer in its plate circuit, and so amplify a second stage again, say 5 or 10 times. Likewise a third valve may be used, and the result is a magnification of potential by three valves, which is, say, $10\times10\times10$ that of a single valve (see Fig. 73).

This arrangement of three valves coupled by transformers is called a *three-stage amplifier.* There is hardly any limit to the degree of amplification obtainable in this manner by a number of valves in series.

We can not only amplify the high frequency oscillations called *radio-amplification,* but we can amplify the rectified groups of damped oscillations which have a low frequency, and this is called *audio-amplification.*

The great achievements of modern wireless telegraphy, such as the transmission of radio messages to the antipodes and their detection at distances of 10,000 or 12,000 miles, are altogether and entirely due to the invention of the thermionic valve and to the power it has given us of amplifying to any extent extraordinarily feeble electric oscillations produced in aerial receiving wires by electric waves. Before concluding this section a brief reference must be made to the use of *crystal rectifiers* as a means of detecting feeble electric oscillations.

CRYSTAL RECTIFIERS

It has been found that certain crystals possess the power of conducting electricity better in one direction than in the opposite; that is to say, in certain directions through the crystal there is an unsymmetrical conductivity. This is particularly marked, as first shown by General Dunwoody in the United States, in crystals of carborundum. This material is a highly crystalline compound of carbon and silicon, chemically called a carbide of silicon, and made in an electric furnace by heating to a very high temperature a mixture of powdered coke and sand. Certain of these crystals of carborundum, if mounted between metal clips or supports, are found to offer less resistance in one direction than in the opposite to an electric current. Hence such a crystal, when inserted in a circuit in which electric oscillations are produced, rectifies them or converts them into a direct current just as does the two-electrode or Fleming thermionic valve. Groups of electric oscillations can thus be rectified into intermittent gushes of electricity in one direction and thus affect a telephone receiver.

We are not able to say exactly at the present time what is the reason for this curious lopsided electric conductivity in certain crystals, but it must depend upon an asymmetry of structure. The same property is possessed by a native sulphide of molybdenum called molybdenite, as found by Professor G. W. Pierce.

Also the contact point of many pairs of crystals or minerals has the same property.

If we place in contact a piece of zincite which is a natural oxide of zinc, and a piece of chalcopyrite, otherwise called copper pyrites, which is a sulphide of copper and iron, it is found that certain contact places have a rectifying power upon electric oscillations.

Again the contact point of a bit of plumbago (black lead pencil) and galena or sulphide of lead has a similar rectifying power. These crystals or contacts can therefore be used in series with a telephone receiver to rectify or convert into direct currents groups of electric oscillations.

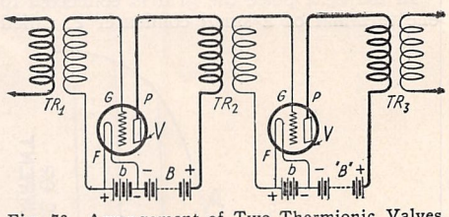


Fig. 73. Arrangement of Two Thermionic Valves, Coupled in Series by Induction Coils, to Amplify Electric Oscillations.

These then become audible as sounds in a telephone receiver, which are either continuous sounds cut up into Morse code signals in wireless telegraphy, or speech sounds as explained further on in wireless telephony.

In the common crystal receiving sets now being sold for broadcasting wireless telegraphy, the crystal is a specially treated

piece of galena, and against it is pressed a flexible copper wire called a "cat whisker."

NATURE OF ARTICULATE SOUNDS

Before we can discuss the application of the scientific facts and principles previously described in the development of practical wireless telephony it will be desirable to preface it by a little further consideration of the physical nature of articulate sounds and some description of the instruments employed in the transformation of the energy of aerial vibrations involved into or from correspondingly varying electric current energy.

It has been explained that aerial waves consist in a state of compression at some point in the air, associated with an accompanying state of rarefaction, which states are not stationary at one place, but are propagated through the air with a velocity of about 1,100 ft. per second at ordinary temperatures. The production of these compressional and rarefactional regions is the result of oscillatory movements of the air particles moving to and fro along the line of propagation of the wave. If the motion of the air molecule resembles that of the bob of a long pendulum it is called a simple harmonic or simple periodic motion. The corresponding aerial waves are called simple harmonic waves, and the sensation they produce when acting on the human ear is that of a pure or simple tone such as that given out by a tuning fork or open organ pipe gently blown.

We have also explained that the oscillatory motion of the air particle may be of a more complicated nature, such that the displacement of the particle or the air pressure at any point and at various times, can only be represented by the ordinates or heights of a complex curve called the wave-form curve, the horizontal distances representing the flow of *time*. The wave form of a pure musical tone, or simple harmonic wave, is a curve called a *sine curve* (see Fig. 74).

It has been mentioned that, however complicated or irregular a wave form curve may be, it can always be imitated by adding together the ordinates of suitably placed simple harmonic curves of various amplitudes and of wave length in the ratio of 1, ½, ⅓, ¼, etc., or some selection of such waves. These last are called the harmonic constituents of the complex curve.

The equivalent statement in terms of sensations of sound is that any continuous sound having any *quality* corresponding to a certain wave form can be reproduced by simultaneous pure sounds or tones of suitable amplitude and phase difference. If, then, we consider the nature of the sounds made in articulate speech we find that very broadly they may be divided into two classes, viz., (i) Continuous sounds, which are uttered by placing the mouth cavity, lips and tongue, in certain positions, and then forcing air out

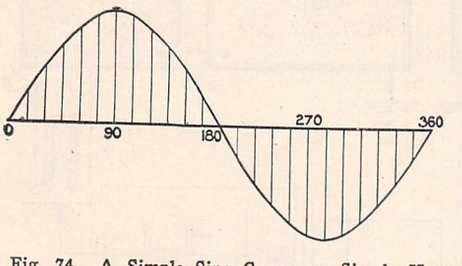


Fig. 74. A Simple Sine Curve, or Simple Harmonic Curve, Being the Wave Form of a Pure Musical Tone.

from the lungs. These sounds can be emitted as long as the breath lasts.

If we except certain sibilant hissing or rolling sounds, such as those indicated by the letters, *s, sh, th* and *r*, we may call the remaining continuous sounds *vowel sounds*. In every language there are a large number of such sounds of different *quality*, and therefore, physically speaking, different wave forms. In English there are about 19 or 20 sounds which are expressed by different modes of sounding the so-called vowel letters, *a, e, i, o, u*, or combinations of them, such as *au, ou, ei, ae. oe*, etc.

Then we have also (ii) discontinuous or consonantal sounds, which for the most part are various abrupt modes of beginning or ending the utterance of a vowel sound. All spoken languages are made up of certain vocal elements called *syllables*, which, combined together or alone, makes *words*. A syllable comprises generally a vowel sound, which may be begun or ended with a consonantal sound or some other continuous sound of short duration. Physically speaking, and outside of ourselves, such syllabic sounds consist in short trains of damped aerial waves of complex wave form and of a certain amplitude and wave-length, determining the loudness and pitch of the sound, the said trains being begun or ended, perhaps, in an abrupt or irregular manner corresponding to the consonant. The acquirement of a language consists in learning to associate particular vocal sounds, or groups of them, with certain objects, actions, or ideas.

The art of speech consists in being able to so control the vocal organs, larynx, lips, tongue, mouth cavity, breath, as to create the types of air wave trains which are by custom associated with certain ideas, things, actions, or wants. The human ear, by education, acquires an extraordinary power of distinguishing between the wave forms of aerial waves which strike the tympanum, and noting the manner in which this wave train begins and ends. If, for instance, we pronounce the monosyllabic words *day, die, do, dough*, or *tea, tie, too, toe*, we are, in fact, creating short rapidly damped wave trains of aerial waves differing somewhat in wave form and in the manner in which the wave train begins. Each of these words is associated in our minds with a thing or idea, and a *word* is therefore a more or less complicated sound of a certain finite duration and wave form which, when made, raises in the mind of a hearer an idea or conception similar to that in the mind of the speaker.

In order that the word shall be correctly interpreted by the hearer, it is necessary that it shall be uttered with sufficient *loudness* and sufficient *clearness*. This implies that the sound-waves must have adequate *amplitude* and sufficiently well defined *wave form* both in the terminal and medial portions of the wave train. The proper pronunciation of the terminal consonants in each syllable is important. Far too many people mumble or clip their words or run them together in speaking.

It is astonishing how few of those whose trade it is to speak in public, such as clergymen, barristers and politicians, are properly trained in the art of elocution.

TWO TELEPHONE TRANSMITTERS

The problem of transmitting speech to a distance, that is, the art of telephony, consists in arranging means by which the aerial vibrations constituting speech sounds which are uttered at one place can be reproduced at a distant place with sufficient amplitude and correctness of wave form to be heard and understood.

Although various attempts and suggestions for the solution of this problem had been made, no one had completely solved it until Alexander Graham Bell invented, in 1875, the speaking telephone, and this, coupled with the inventions of Edison, Hughes and others, as regards the carbon microphone transmitter, gave us practical telephony capable of operation in everyday life. Except in matters of detail it is remarkable that the fundamental principles of the apparatus remain to-day what they were forty-six years ago.

Bell realized at a very early stage in his experiments that to achieve telephony by the aid of an electric current, the current in the wire must vary in strength with time exactly in accordance with the variations in air pressure made by the voice of the speaker at a point near his mouth. This means that the current must be an undulatory current.

Bell's solution of the problem of telephony was a remarkable stroke of genius, involving as it did the production of a novel yet most simple appliance which could act both as transmitter and receiver. He placed on the pole of a bar, or poles of a horseshoe-shaped

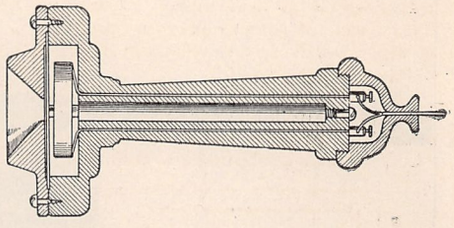


Fig. 75. Section of a Bell Magneto Telephone.

permanent magnet, soft iron pole pieces wound over with insulated wire. Very near to these pole pieces was fixed a circular flexible disc of thin iron about 2¼" in diameter (see Fig. 75). When the coils of wire are traversed by a fluctuating electric current the magnetic poles are either weakened or strengthened a little. The disc, or diaphragm, as it is called, is therefore cupped, or bent in a little more, or else springs back suddenly. The amplitude of motion of the center of the diaphragm is in any case extremely small, never exceeding 1/100th of a millimeter yet the blow it inflicts on the air is sufficient to create an air wave, and therefore an audible sound, and the movements of the disc respond so quickly to changes in the current that the receiver can impress upon the air waves of a complex wave form which yield intelligible speech sounds.

On the other hand, if we speak to the diaphragm the changes of air pressure made by the speech waves against the disc press it in or out. When the iron disc is moved nearer to the magnet poles it increases the pole strength slightly, and this creates an induced electric current in the surrounding coils of insulated wire, the variation in which copies to a certain extent the motion of the disc.

Hence, if two similar telephones have their coils joined by a pair of transmitting wires, speech made against the diaphragm of one telephone is faintly repeated by the diaphragm of the other, and the arrangement conveys audible speech to a distance.

It was, however, soon found that although the above-described Bell telephone is a remarkably good speech reproducer, it is not very effective as a transmitter, and it was soon replaced in this respect by the carbon microphone resulting from the discoveries and inventions of Edison and of Hughes.

In this transmitter the movements of the disc or diaphragm created by the speech sounds is made to compress more or less some granules of graphite or hard conductive carbon, and this pressure varies the electric conductivity of the mass of granules. Hence, if this carbon forms part of the electric circuit of a voltaic battery, changes of current will take place in that circuit corresponding to the movements of the diaphragm.

Without entering into details of development we may describe one or two modern microphone transmitters as used in telephony, both with wire circuits and in wireless telephony as well.

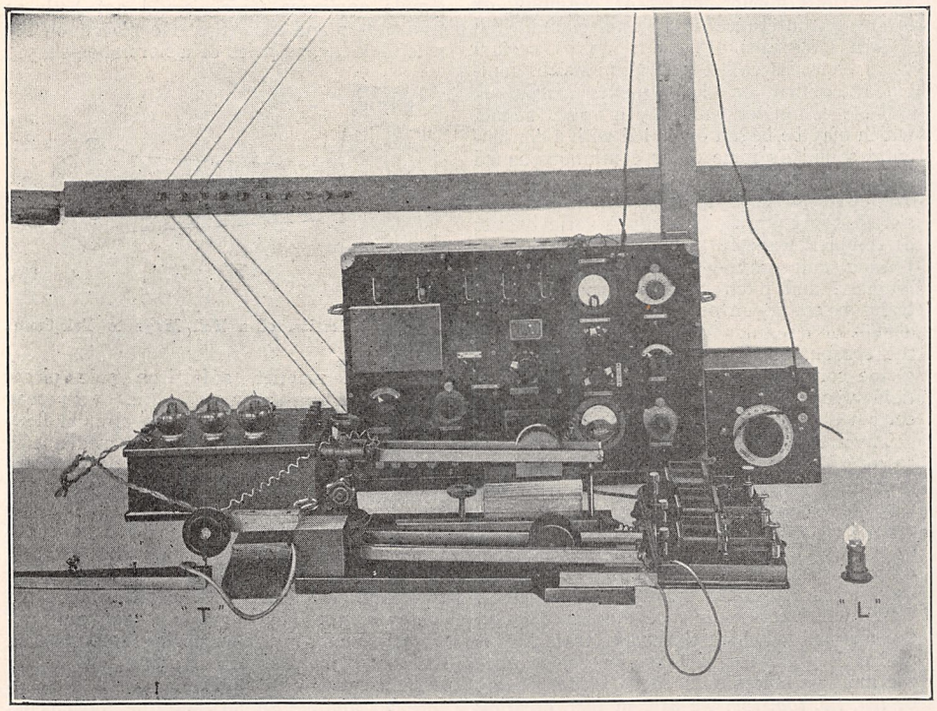
In its usual form one of them is termed a "solid back" transmitter. It was invented by Mr. A. C. White in America. It comprises an ebonite trumpet-shaped mouthpiece, which may be replaced by a large metal cone, the function of which is to collect the sound waves and converge them on to a thin circular diaphragm or disc of aluminum, about 2½" in diameter, and about 1/50" in

(*Continued on page* 115)

A New System of Radio Control

By CAPTAIN H. W. WEBBE, A. I. E. E.

ASSISTANT PROFESSOR, COMMUNICATIONS, MILITARY DEPARTMENT, OHIO STATE UNIVERSITY.



The Complete Receiving System Used During the Experiments with Radio Control. The Large and Small Tuning Forks Which Form the Basis of This New Development Can Be Seen Directly in Front of the Signal Corps Receiving Set. The Relays to the Right of the Tuning Forks Control a "Calling Circuit" Containing a Small Light.

"COMING events cast their shadows." The world's epoch-making inventions have been forecast by a public curiosity and concern. The telephone, the automobile, the aeroplane and radio were thus heralded. Many investigators were busy in these various fields before they appeared. The public, after reviewing their efforts, gave approval to the more practical, and immediately these dreams became actualities. Radio control can be said to be in this category. The public curiosity and interest manifested when a radio car bumps along the street, a boat is guided, or an aeroplane is controlled, testifies that radio control will be one of the next utilities to emerge from that mysterious realm, creative genius. One of the objects of this paper is to appeal to the young experimenters of the country. Get busy along this line! The public is an impartial judge and plays no favorites. The most humble reader of these pages may hit upon the secret that will release radio control from the experimental stage to take its proper place among the servants of man. The possibilities for radio, when this shall have happened, seem infinite. The locomotive engineer can throw his own switches. The electrification of long stretches of railroads is made more practicable when, by a system of radio control, power may be turned on and off as trains approach and leave divisions. Radio telephony will change from a toy to a real factor in the affairs of man. These are in addition to the many novel schemes for aeroplanes, boats, and cars.

NEW SYSTEM DEVELOPED

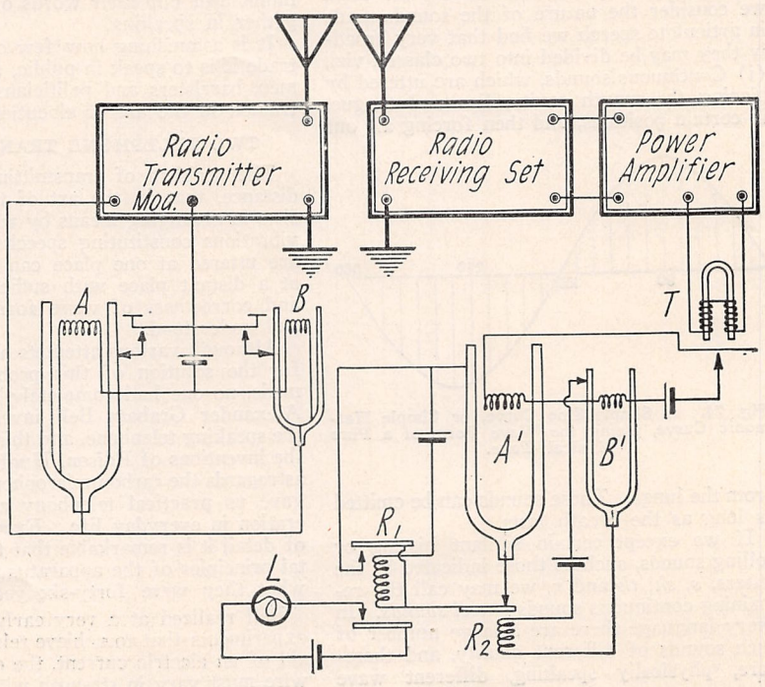
A radio control system has been worked out at the signal laboratory of the R. O. T. C. at Ohio State University. Before discussing our system, it might be well to speak briefly of present methods. We shall limit ourselves to principles. It should be evident that radio control was a possibility from the very inception of the art of radio. The first coherer set of Marconi is a true sample. The coherer had sufficient power to close a relay, and that is the first key to control; to transmit an impulse and have it perform a perceptible amount of work at the receiver. The next step is to differentiate so that impulses may be made to perform more than one task. Inventors have accomplished this by ratchets, sensitive galvonometer relays, subcarrier trigger oscillatory circuits, and the like. Space does not permit of their discussion.

Our work has been a departure from the above. We have evolved a system using the principle of sympathetic vibration. Some discussion of the principle is necessary to the proper understanding of our system. In the accompanying photograph (No. 1) the two large forks are in resonance, and likewise the two small ones. By sounding one of the large forks the other large one vibrates in sympathy and gives out the same tone. At the same time the small forks are quiet. By sounding one of the smaller forks the reverse action happens. We have here the phenomenon of energy passing from one point to another seemingly without a medium. The air, however, conveys the impulses from one fork to the other. If you were to feel the forks while in motion you would note an appreciable movement, almost sufficient to close a contact. We have a differential control system here with the air as a medium. Substitute the ether for air and we could extend this control indefinitely. This idea of sympathetic vibration is associated with many of the world's epoch-making inventions, including radio. Bell, while experimenting with this principle, discovered the telephone instead. Varley, an Englishman, produced a multiplex telegraph system based on sympathetic vibration. This was years ago, back in the '70s. A more recent application is found in patents granted on radio devices in the days of the coherer.

TUNING FORKS ARE USED.

Early radio inventors put the tuning fork to a number of ingenious uses, such as interference elimination and greater selectivity of signals. These ideas were still-born. They died in the Patent Office. The coherer was too erratic and unreliable, and later the crystal and audion detector employing feeble currents choked out their possibilities. However, as evidence that inventors in these early days were thinking of using this principle in radio control, we will quote the case of one who was granted a patent on a system of sympathetic pendulums, to be used in an announciator system on a single wire. This inventor said, "My invention can be used in radio if a coherer can be found of quick enough action to record the impulses." We believe such a coherer does exist, but called by a different name and embodying different principles.

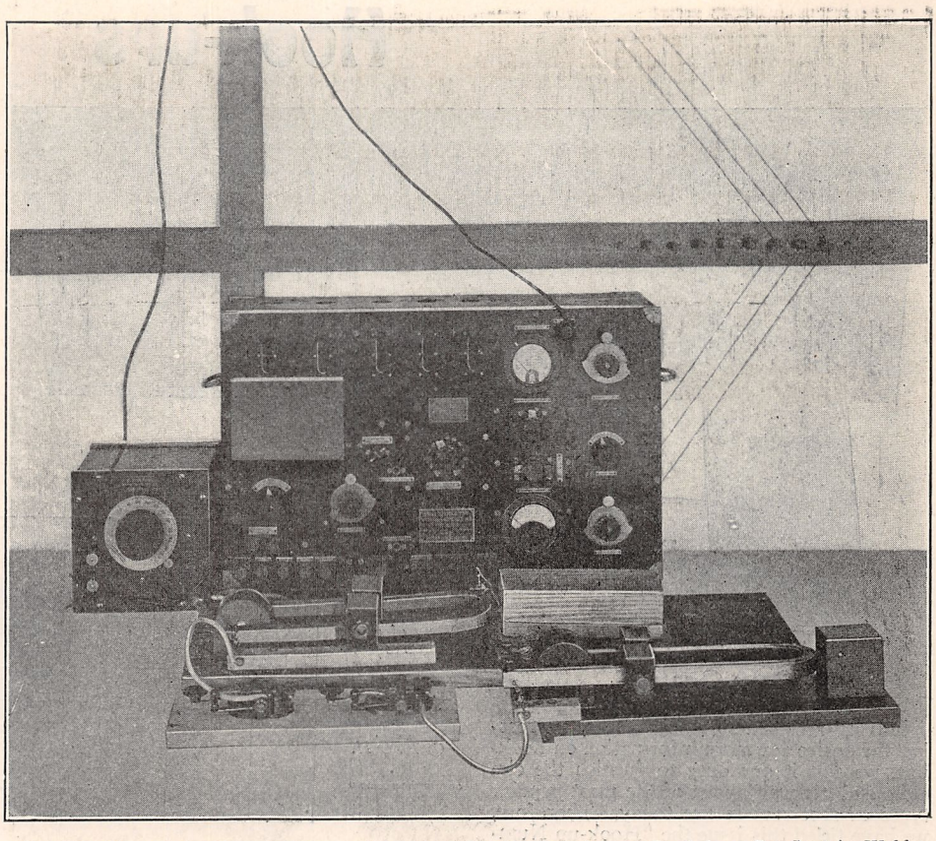
We will now take up the subject proper of this paper. Early in the Fall of 1922, the writer was asked by Professor Caldwell



(A) The Transmitting and Receiving Circuits of the Radio Control System Developed by Captain Webbe. In Principle, the Vibrations of Tuning Fork B Are Impressed Upon a Carrier Wave and Transmitted. When Picked Up by the Receiver, Tuning Fork B^1 Vibrates in Sympathy. Tuning Forks A and A^1 Will Quench Any Tendency of Continued Vibration on the Part of Forks B and B^1 Respectively, Once the Proper Control is Completed.

of the Electrical Engineering College to prepare a talk on radio with demonstrations for members of the Columbus chapter of the American Institute of Electrical Engineers who were to visit the university in a body. We selected the subject of radio control and built a wagon for a preliminary test. We used the coherer to start with, and proceeded to investigate the various other methods of control already mentioned. None of these seemed adapted to accomplishing the best results. We finally adopted a suggestion of my associate, Mr. Edwards. We investigated the use of tuning forks for radio control. Our troubles began when we tried to secure the proper kind of forks. The physics department hesitated to allow their standard types to be loaned. They turned over to us three large electrically vibrated ones about a foot and a half long, clumsy and crude. We were reluctant to take them at first, but they turned out to be of a distinct advantage. We persuaded the college blacksmith to make a fourth so that we might have two pairs to work with. Right here is an important point; the blacksmith has supplanted the jeweler in the making of an essential part for radio control. Having secured the forks, we had the following problems to overcome:

1. To find resonant points in these forks so that one fork on one frequency would seek out and actuate its mate on the same frequency and likewise with the other two on a different frequency.
2. To impart to a radio wave the impulses from the tuning fork and to convey them to a distant station.
3. Having transmitted these frequencies to a distant station, to convey them to the coils of the receiving forks in such a way as to cause them to set one in motion while the other was quiet and vice versa.
4. A means must be found to overcome the difficulty due to a fork continuing to vibrate after it has performed its work. This is important when instantaneous control is desired.

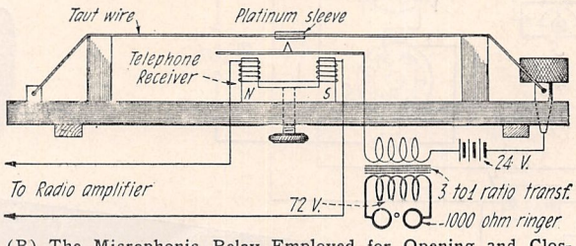


This is a View of the Complete Transmitter Used for the Expe iments Carried on By Captain Webbe and His Associates. A Better View of the Tuning Forks is Had from This Photograph. Since the Transmitter and Receiver Were Operated at Short Distances from Each Other, Loop Aerials Were Used as Collective Agencies. They Are Seen in Both Photographs Directly Behind the Apparatus.

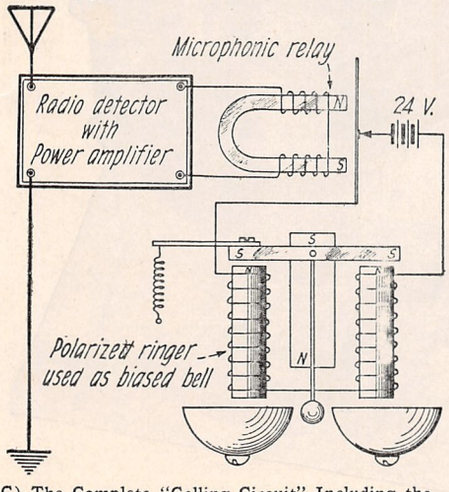
FINDING RESONANT POINTS

To meet our first problem, we connected the four forks on a wired circuit in order to locate resonant points. The two that were to be used at the transmitting station were booked up after the method of vibrating buzzers and connected to keys to operate them separately. The two at the receiving end were simply wired in series. By shifting weights we finally located resonance points so that one fork at the sending point vibrating at 100 cycles per second would seek out and actuate its mate at the other end of the wire, and likewise with the other pair vibrating at 120.

Our second problem was not difficult. We used an Army S. C. R. 67 radio telephone set, a type used in the field during the recent war. This instrument generated our radio wave called a carrier. One wavelength was used. The tuning forks with telegraph keys to turn them on were connected to the modulation transformer of the set; as a matter of fact, substituted in the place of the regular telephone transmitter. When the key was pressed down the fork vibrated and impressed its frequency on the modulation circuit in the same manner as the vibrations of the voice or a musical concert do, except that the tone was constant. By the carrier wave this tone was transmitted to the receiving set and was received, when properly tuned, as a dull roar similar to a 60-cycle hum only faster and much more pronounced.



(B) The Microphonic Relay Employed for Opening and Closing the Circuit of the Polarized Bell Ringer. Note That the Circuit is Divided by a Transformer.



(C) The Complete "Calling Circuit" Including the Receiving and Amplifying Apparatus, the Relay and the Bell Ringer.

TUNING FORKS DIFFICULT TO STOP

Our third problem was more difficult. At our receiving station we used the receiving apparatus of the S. C. R. 67 set, consisting of an audio detector circuit and two stages of audio frequency. Added to this we used a Western Electric loud-speaker amplifier. The forks we had hoped to procure for this experiment were small and delicate, with thin prongs and very highly wound coils. In their stead we had to be content with forks of the size of small sledge hammers, having coils of a very low number of winding turns. Naturally, we could not expect them to operate on the minute currents of the amplifier. One hundred milliamperes were needed to start these forks, and about 60 to keep them in motion. To meet this, an amplifier unit using 50-watt tubes with 600 volts on the plate was built. Still we were unable to vibrate the forks. The current variation was insufficient. We were quite discouraged. We did not care to try audio oscillation, as our apparatus was becoming too elaborate. This was the situation four days before the demonstration. The student staff had gone for the day, excepting Mr. Gravitt. We had removed the 50-watt amplifier equipment, so that the set now consisted of the original detector circuit and the Western Electric power amplifier. We had placed a loud-speaker on the amplifier. The fork at the transmitting station was going. A loud roar was coming from the loud-speaker. The writer placed his finger in the aperture that leads to the diaphragm, which was moving up and down over a wide amplitude at the frequency of the transmitting fork. Immediately the idea occurred of the practicability of using a microphonic type relay. By using this relay any desired current could be applied to the coils of the forks and the current variations would be 100 per cent. For those who may not be familiar with the microphonic relay, it is nothing more or less than a telephone receiver with a contact bearing on the diaphragm which makes and breaks as the diaphragm responds to current passing through the receiver. The radical motion in the loud speaker insured that such a relay would have a positive action. This was explained to Mr. Gravitt and we improvised such a relay out of an ordinary Kellogg low resistance receiver at hand. A small platinum disk was soldered to the center of the diaphragm and a spiral with a platinum point was used for a contact. This relay was placed between the amplifier and the coils of the forks. A small battery of two cells was used in the coil circuit. The forks began to vibrate and responded each in its proper turn to its mate at the transmitting station. Tube noises did not seem to affect the action of the forks.

(*Continued on page* 94)

Hook-ups

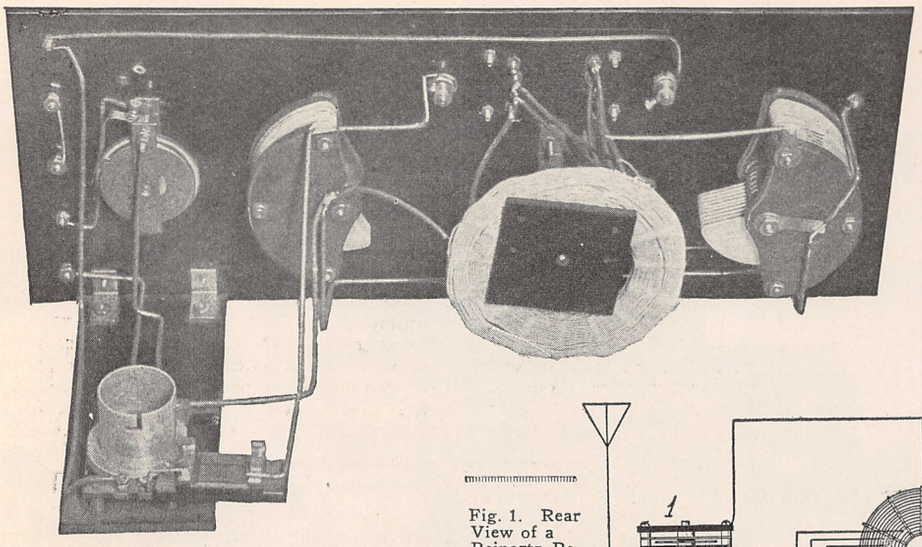


Fig. 1. Rear View of a Reinartz Receiver. Fig. 2. Hook-up for the Receiver Shown in Fig. 1.
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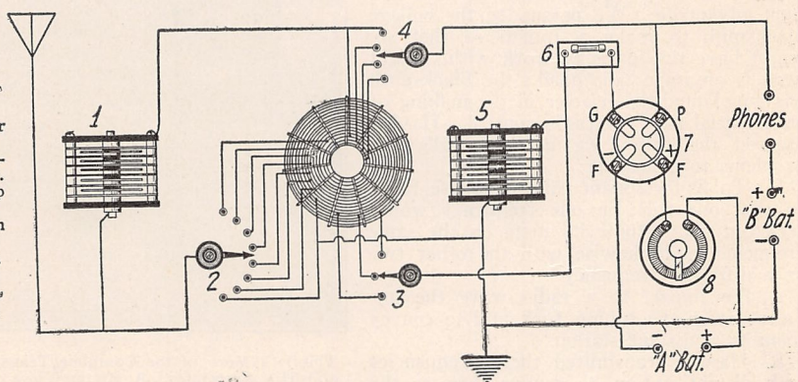
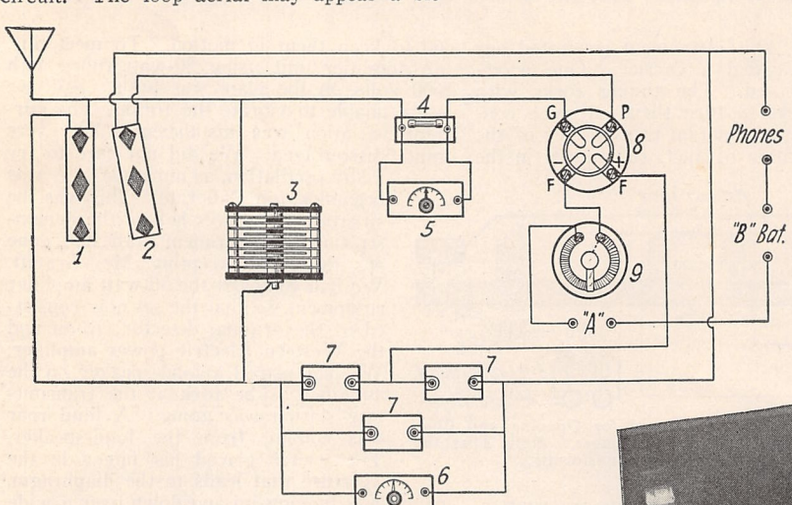
Our Cover

Having received so many letters, expressing the desire for more information on hook-ups, we felt it our duty to furnish the circuits and general layout of the most popular types of receivers in use today. Therefore, we have titled this issue the "Hook-up Number." Our cover portrays a youthful experimenter in the act of trying out a new circuit. The loop aerial may appear a bit





out of the ordinary. Instead of wire, it is wound with thin copper ribbon about .005" thick; width ¼" or $\frac{3}{16}$". This has proven to be more efficient than the usual "wire-wound" loop. It is to be recommended to those who are seeking efficiency.

The Reinartz Receiver

The Reinartz receiver has become very popular because of the simplicity of its construction and the excellent results that can be obtained. It is well suited for the reception of both broadcasting stations and amateur stations, and has in some instances been able to receive from very distant points. A photograph of a well constructed Reinartz receiver is shown in Fig. 1, with the corresponding wiring diagram in Fig. 2. As may be seen, the main instruments are two variable condensers and a spiderweb coil. The variable condenser marked 1 in the diagram is the one to the right of the spiderweb coil in the photograph, condenser 5 being to the left. Both of these condensers have a capacity of approximately .0005 MF. each (23 plates). The switch-arms 2 and 3 are used in conjunction with condenser 1, for tuning, while switch-arm 4 and condenser 5 control the regeneration; 6 is a standard .00025 MF. condenser and a 1-megohm grid leak. In the photograph this is shown attached directly to the tube socket. The spiderweb inductance is, really, two distinct coils on one form. The first coil has 45 turns, taps being connected to the points of switch 4, from 0, 15th, 30th and 45th turns. The second coil has 40 turns. Take taps off at 2, 4, 6, 7, 8, 9, 10 and 11 turns and connect them to switch 2. Taps for the points of switch 3 are taken off at the 26th, 33d and 40th turns. If a WD-11 tube is used, a dry cell should be connected to the "A" battery posts instead of a 6-volt storage battery.

The Flewelling Receiver

A one-tube Flewelling set can deliver enough volume to nicely work a loud-speaker. When properly operated, it is capable of long-distance reception. A well de-

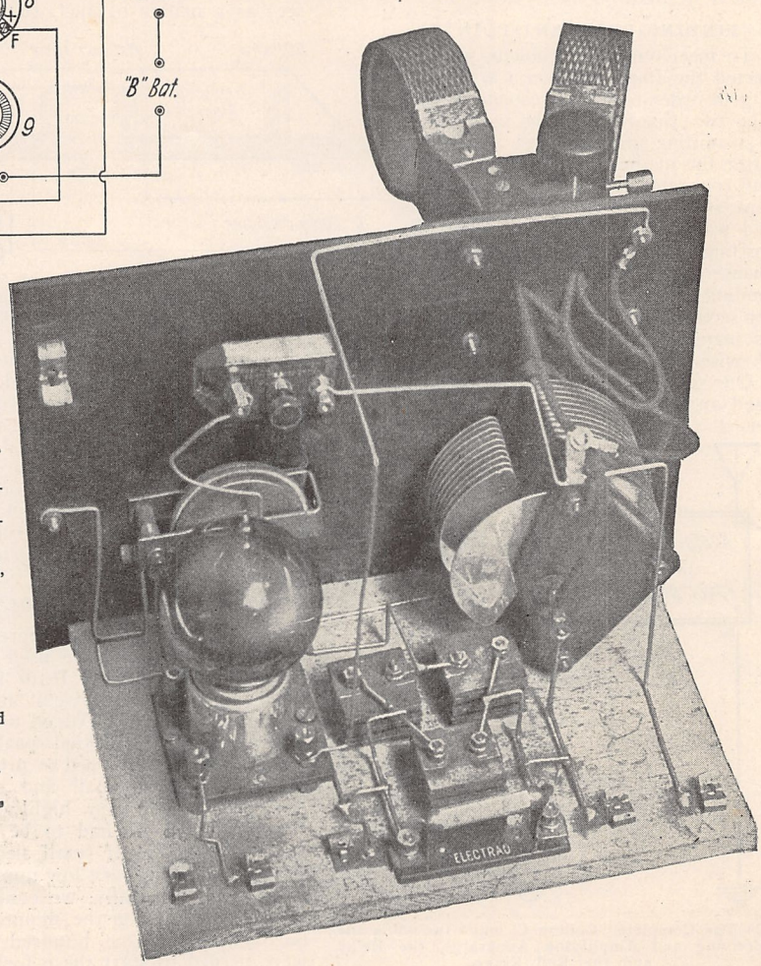


Fig. 3. A Photograph of a Flewelling Receiver. The Apparatus is Well Arranged, Allowing for Short Connections. Fig. 4. The Wiring Diagram for the Flewelling Set. No Ground Connection is Used in This Circuit.
© K. & H.

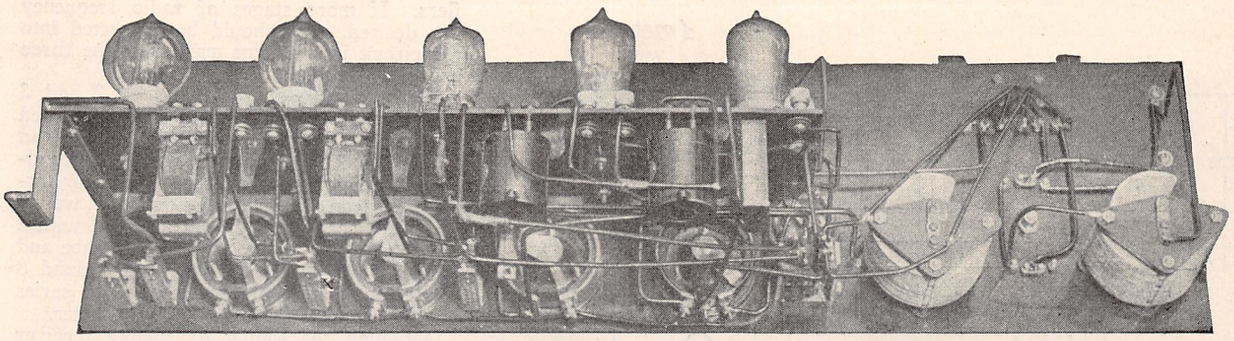


Fig. 5. A Sensitive Receiver, Built For Both Distance and Volume. It Employs Two Stages of Radio Frequency Amplification, a Detector and Two Stages of Audio Frequency Amplification. The Potentiometer Is Mounted To the Right of the Three Filament Rheostats.

signed Flewelling set is shown in Fig. 3, with its wiring diagram in Fg. 4. The two honeycomb coils 1 and 2 are mounted on the front of the panel. These are of 50 and 75 turns, respectively. The variable condenser 3 is one with 43 plates and a combined vernier; 4 is a .00025 MF. grid condenser, and 5 is a variable grid leak, having a comparatively low minimum resistance. The three condensers 7 are each of .006 MF. capacity. The set shown in the photograph uses three banks of condensers, each bank consisting of three fixed condensers of .002 MF. capacity, thus making a total of .006 MF. in each of the three banks. The grid leak 6 need not be of the variable type. This set works best when using a VT-1, VT-2, UV-201, C-301, UV-201A or C-301A and a "B" battery of from 45 to 100 volts.

It is necessary that the best quality of apparatus be used in this receiver or the results obtained will be poor.

A Long Distance Receiver

One can receive from great distances with a receiver of the type shown in Figs. 5 and 6. It consists of two stages of radio frequency amplification, detector and two stages of audio frequency amplification. Tuning is accomplished by the use of honeycomb coils and variable condensers. It is possible to cover any band of wave-lengths desired by plugging in honeycomb coils having the proper number of turns. The radio frequency amplifiers may be cut in or out of the circuit by the manipulation of switches S2 and S3, the amplifiers being cut out when both switches are placed on points D, and cut into the circuit when the switches are thrown to points R. The honeycomb coil marked T is employed for regeneration. The variable condenser marked PC is used for tuning the primary circuit, and may be placed in series, or parallel with the honeycomb coil P, by means of the switch S1. The same switch is used to cut this variable condenser out of the circuit. The variable condenser SC is connected across honeycomb coil S, and is used for tuning the secondary circuit. These condensers each have 43 plates. The potentiometer should have a range of resistance from 200 to 400 ohms. The honeycomb coils do not show up in the photograph. They are plugged in to a three-coil mounting, which is attached to the front of the panel.

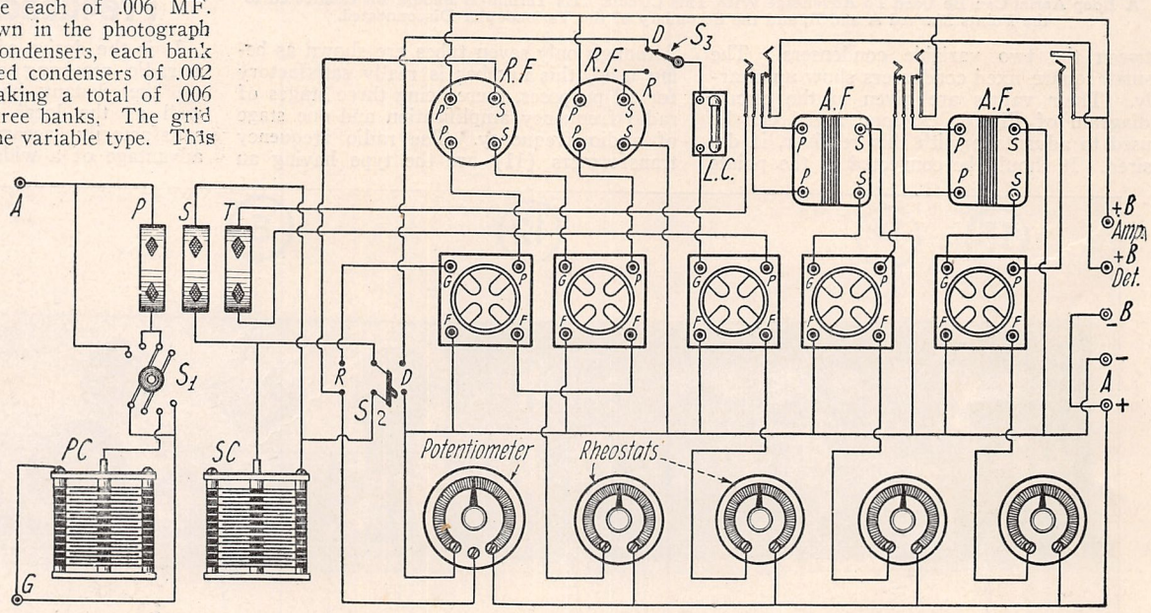
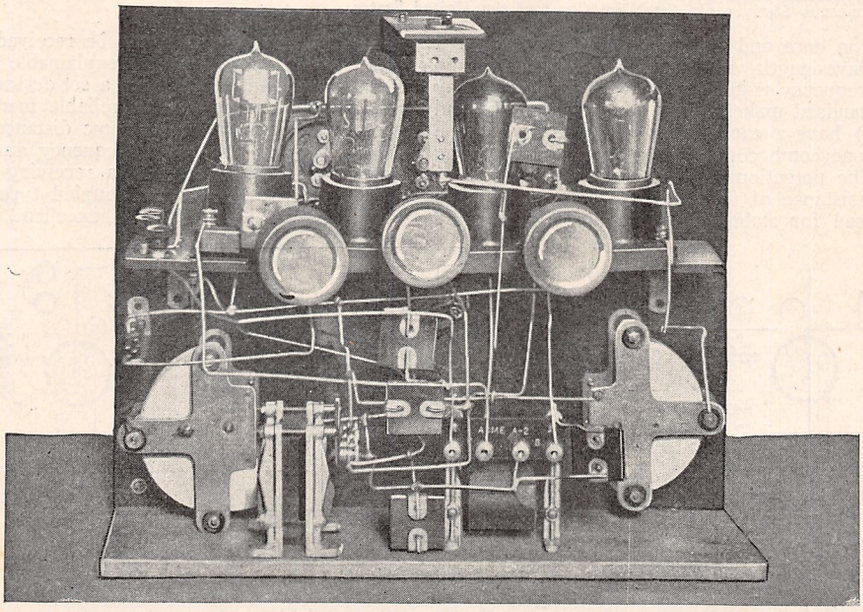


Fig. 6. The Circuit For the Receiving Set Shown In Fig. 5. Although a Rheostat Is Shown For the Filament of Each Tube, the Pair of Radio Frequency Tubes and the Pair of Audio Frequency Tubes Can Each Be Controlled By One Rheostat.



A Four-Tube Reflex Receiver That Furnishes Three Stages of Radio Frequency Amplification and Two Stages of Audio Frequency Amplification. The Tube on the Extreme Left Is Employed As a Detector. The Small Square Fixed Condensers Are Used to By-Pass the Radio Frequency Currents. Great Distances Can Be Covered With a Receiver of This Type, Using But a Loop Aerial

A Four-Tube Reflex Receiver

The Reflex Receiver might well be called a double-duty outfit, for the tubes do just this. A four-tube reflex set is shown in the photo of Fig. 7, its corresponding hook-up being in Fig. 8. The first three tubes are used for five stages of amplification, three of radio frequency and two of audio frequency. The last tube acts as the detector, and is used in conjunction with the usual grid leak and condenser. The two variable condensers provide the means for tuning. One is connected in series with the primary coil of the variocoupler, and the other is in shunt with the secondary coil. In the photograph, the radio frequency transformers are seen mounted at right angles to the vacuum tube shelf. The two audio frequency transformers are mounted on the base, be-

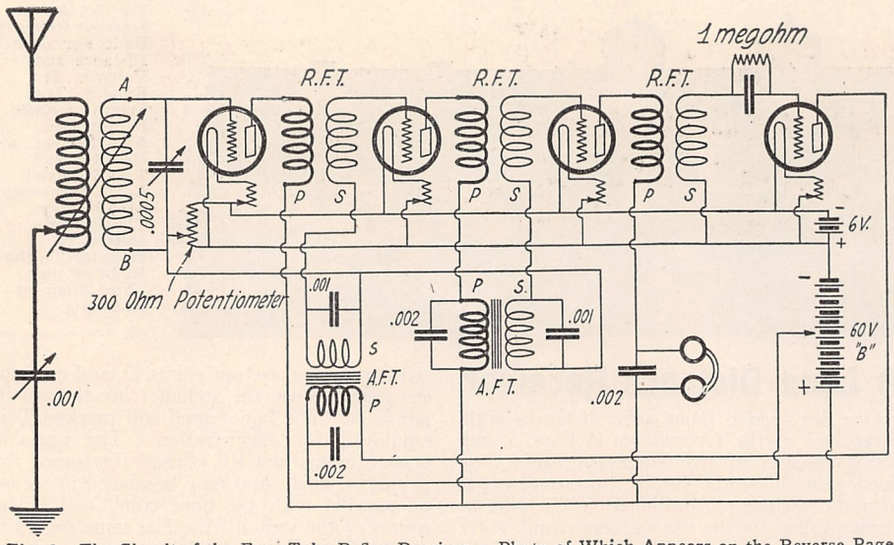


Fig. 8. The Circuit of the Four-Tube Reflex Receiver, a Photo of Which Appears on the Reverse Page. A Loop Aerial Can Be Used To Advantage With This Circuit. Its Terminals Should Be Connected to the Points Marked A and B, and the Secondary of the Variocoupler Disconnected.

tween the two variable condensers. The small square fixed condensers show up clearly. Their values are given in the circuit diagram of Fig. 8. A loop aerial can be used to advantage with this receiver, if desired. It should be connected to the points marked "A" and "B." The variocoupler, of course, should be disconnected, when the loop is in use.

Super-Heterodyne Receiver

The most sensitive type of receiver known today is the Super-Heterodyne. The front and rear views of such a set are shown in Figs. 9 and 10. This set employs 10 vacuum tubes, one of which is used as an oscillator, two as detectors, five as radio frequency amplifiers, and two as audio frequency amplifiers. The corresponding hook-up of this receiver is shown in Fig. 11. Although only seven tubes are shown as being used, this number is really satisfactory for all purposes, there being three stages of radio frequency amplification and one stage of audio frequency. The radio frequency transformers (11) are the type having an iron core and designed for operation on a wave-length of 5000 meters. The audio frequency transformers (13) can be of any standard make. Variable condensers (8 and 9) have a capacity of .001 MF., while the honeycomb coils (10) each have 250 turns. The potentiometer (12) has a variation of resistance of from zero to 400 ohms and is used for stabilizing the action of the radio frequency amplifiers. If more stages of radio frequency are desired, they should be connected into the circuit in the same manner as the three shown.

In the circuit shown below, 1, 2 and 3 constitute the aerial circuit which is tuned in the usual way. If a loop is used instead of the aerial it takes the place of the secondary of the variocoupler. The oscillator circuit 5 is made of a tube 3" in diameter, wound with 40 turns of No. 20 D.C.C. wire, with a tap at the 20th turn On the same tube and about 2" from the first coil are wound 8 turns of the same wire, connected in series with the secondary of the variocoupler.

Although the tuning of such a receiver may seem difficult at first, it is not, in fact, more complicated than that of an ordinary three-circuit regenerative receiver. When a loop aerial is used there are only two controls, the tuning of the loop and the oscillator by means of the variable condensers.

A Tuned Radio Frequency Amplifier

It is the desire of the average owner of a radio receiving set to be able to pick up the distant broadcasting stations, as well as the local ones. If this can be satisfactorily accomplished, there is the advantage of a wide selection of broadcast programs, any of which can be received at will. Again, there is that unexplainable itch for distance that makes such a set desirable.

In order to receive in a reliable manner programs from stations at some distance, it is necessary to use radio frequency amplification in conjunction with a receiving set. Although the transformer coupled type of radio frequency amplifier is excellent, the

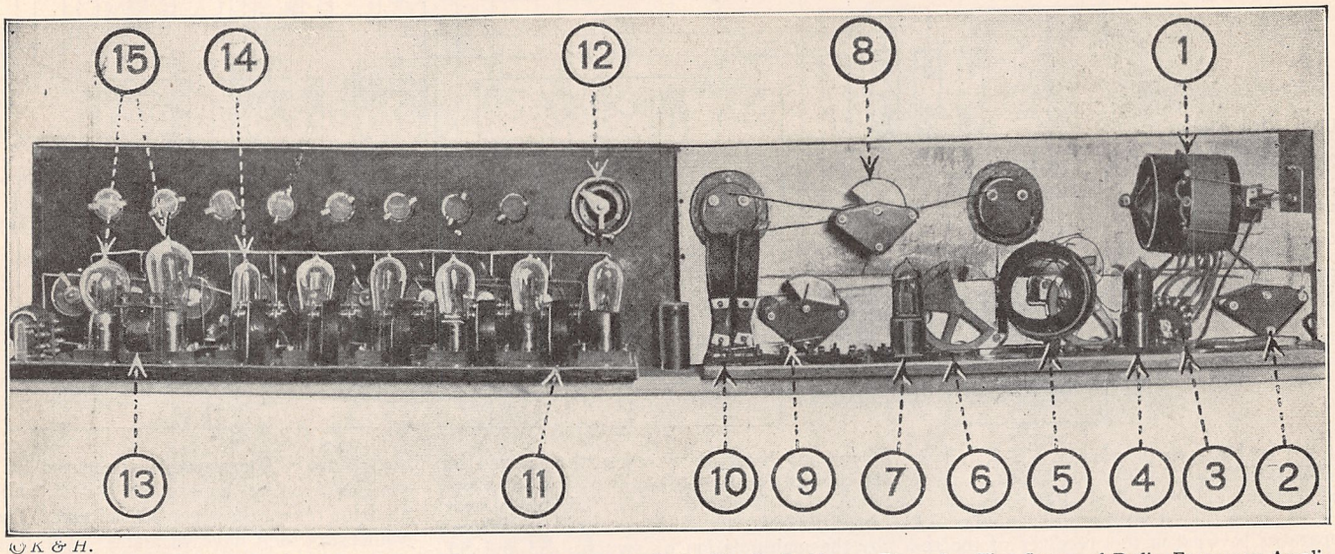


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Fig. 10. A Rear View of the Ten-Tube Super-Heterodyne Receiver Built By Mr. R. R. Mayo. There Are Five Stages of Radio Frequency Amplification and Two Stages of Audio Frequency Amplification Employed in This Set. Mr. Mayo Has Succeeded in Picking Up 2LO, London, As Well As Numerous Stations On the West Coast of the United States.

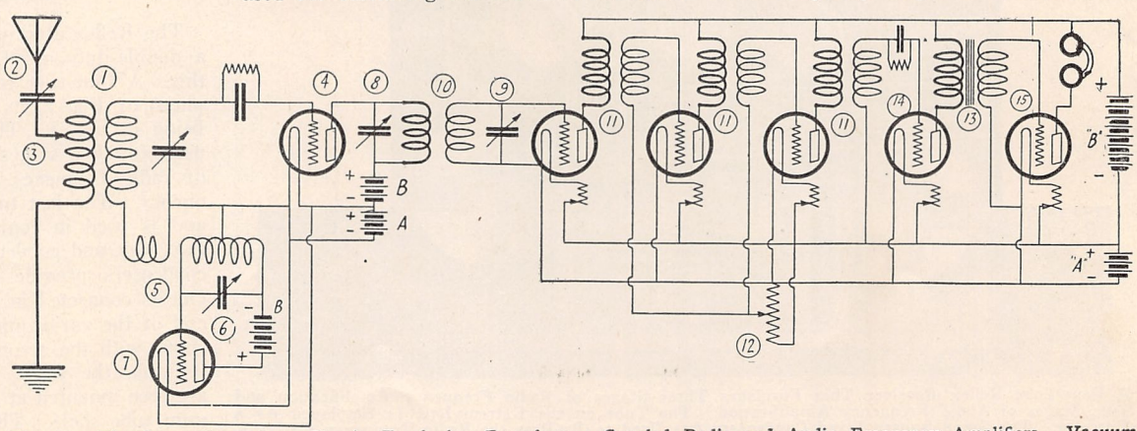


Fig. 11. The Super-Heterodyne Circuit, Employing Transformer Coupled Radio and Audio Frequency Amplifiers. Vacuum Tubes 4 and 14 Function as Detectors. Tube 7 is the Radio Frequency Oscillator. The Aerial and Ground can be Replaced By a Loop Aerial, If Desired.

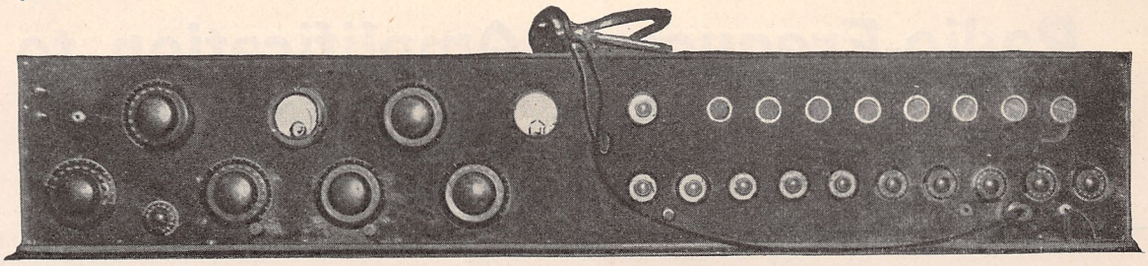


Fig. 9. A Front View of Mr. Mayo's Super-Heterodyne Receiver. The Main Tuning Controls Are Situated Along the Lower Part of the Panel, So As To Be Within Easy Reach. © K & H

type referred to as a tuned impedance amplifier is superior. Where but one stage of radio frequency amplification is to be used, it is advisable to employ this type, as a greater distance can be covered. The WD-11 and UV-199 tubes are very good radio frequency amplifiers, and can be well employed in such a receiver. Very good results can be obtained with but two tubes, utilizing one as a radio frequency amplifier, and giving all the possibilities of distant reception.

This set is easily built, all of the parts being standard. The necessary apparatus required, with their corresponding numbers in the diagram, Fig. 2, are as follows:

(2)-(3). Variocoupler; (4)-(7). Two 23 Plate Variable Condensers, (.0005 MF.) of the same make; (5)-(9). Two vacuum Tubes; (6). DL-35 Honeycomb Coils; (8). Fixed Grid Condenser, (.00025 MF.); (10). Head-Phones; (11)-(15). Two Filament Rheostats; (12). Two 22½-Volt "B" Batteries; (13). 1-Megohm Grid Leak; (14). 200-400 Ohm Potentiometer; (16). Two or more dry cells depending upon the tube used.

Referring to the diagram of Fig. 2, the tube (5) is the radio frequency amplifier, and the tube (9) is the detector. Coils (6) and condenser (7) compose the tuned impedance with which amplification is obtained. The layout of this receiving set is shown in Fig. 1. The apparatus is placed to correspond with the circuit of Fig. 2, i. e., everything is set in the most convenient position for the allowance of short, direct wiring. Where it is possible, the same position of apparatus should be followed when mounting it on a panel. The DL-35 honeycomb coil may be replaced with a single-layer coil, if so desired. In such a case, the coil should be wound on a tube having the same diameter as the secondary coil of the variocoupler, but with about 10 turns of wire less. In other words, this coil should be identical with the secondary coil of the variocoupler used, except for the number of turns.

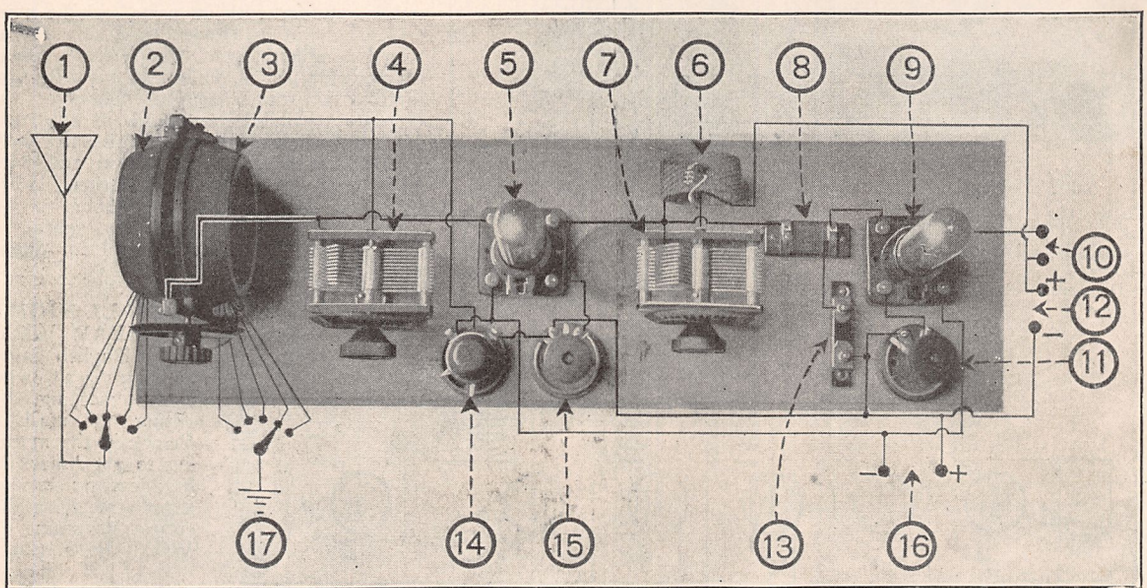


Fig. 1. Layout and Connections of the Apparatus Composing the "Tuned Radio Frequency Amplifier and Receiver." The First Vacuum Tube is the Radio Frequency Amplifier, the Second Being the Detector. Quite Some Distance Can Be Covered With a Set of this Type. Any Standard Make of Apparatus Can Be Used.

Referring again to the circuit-diagram of Fig. 2, note that the grid leak 13 is connected directly to the positive side of the filament, instead of crossing the grid condenser, as is usually the case. Be sure to connect it as shown.

In regard to the operation of this set: The temperature of the filament of the first audio amplifying tube is not critical. That of the second, or detector tube, however, may require a fine rheostat adjustment. As a first operation, light the two tubes by means of their respective rheostats. The knobs of the rheostats should be turned towards the right until the filaments of both tubes burn a dull red. With the secondary of the variocoupler placed at about the angle shown in the photograph, start tuning the set by adjusting the primary circuit with the switch arm and, at the same time, adjusting the secondary circuit with the variable condenser (4). Continue this operation until a station is picked up. Find the best contact point for the switch arm in the primary circuit. Then, by the simultaneous adjustment of condensers (4) and (7), complete the process of tuning. This last operation is usually rather critical, especially the adjustment of condenser (7), wherein a slight movement of the dial is sufficient to obliterate the signals.

For the reception of long-distance stations, all of the tuning is accomplished by the two variable condensers. For example, if a distant station, which transmits on 360 meters, is desired, the primary switch arm should be placed on the point that was previously found best for reception on this wave-length. The secondary variable condenser (4) is then adjusted to a point where nearby 360-meter stations can be heard. Then, by a very slow simultaneous adjustment of the two variable condensers, all of the waves close to 360 meters are explored, until the desired station is picked up. It is advisable to equip these condensers with Vernier knobs, or purchase variable condensers that have a Vernier condenser included. It is well, for future reference, to copy the scale-readings on the dials of the two variable condensers, where certain stations are received best, as well as the number of the switch-point that gives best results for that wave-length.

During the process of tuning, the operation of the set is apt to become unstable. This is denoted by a sudden plucking noise in the head phones, after which reception is completely spoiled. This unbalanced state is normalized by the use of a stabelizer, which, in reality, is a potentiometer; it is shown in both illustrations, under (14). When the set becomes unstable, as described, this stabelizer knob should be turned to the right, or to the left, until a position is found where normal operation of the receiver is restored. It is advisable to adjust this control each time a station is tuned in.

Standard tubes may be used with this set, if desired, providing standard tube sockets are used and a 6-volt storage battery is provided for the filament supply, instead of the two dry cells. In such a case, the first tube should be a UV-201, a C-301, or a VT-1; while the second or detector tube can be a UV-200, C-300, VT-1, VT-2, or any other type of 6-volt detector tube.

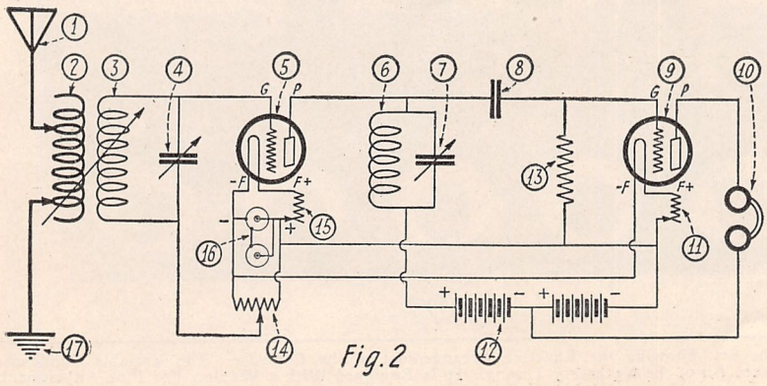
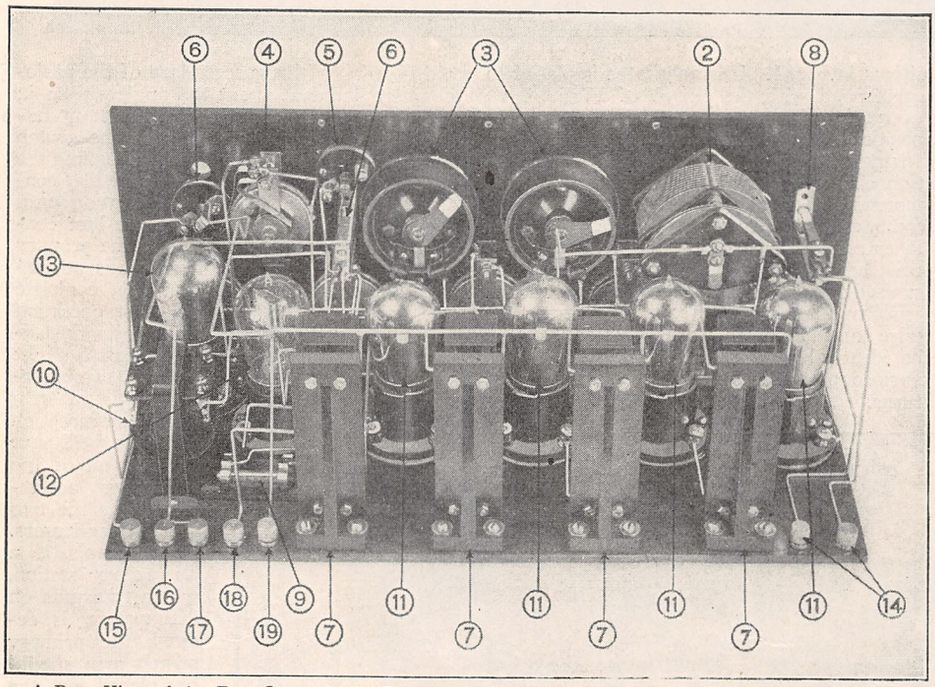


Fig. 2

Wiring Diagram of the Tuned Impedance Radio Frequency Amplifier and Receiver. Dry Cells 16 Are Replaced With a 6-Volt Storage Battery, If a 6-Volt Tube Is To Be Used.

Radio-Frequency Amplification to the "Nth Degree"

By S. R. WINTERS

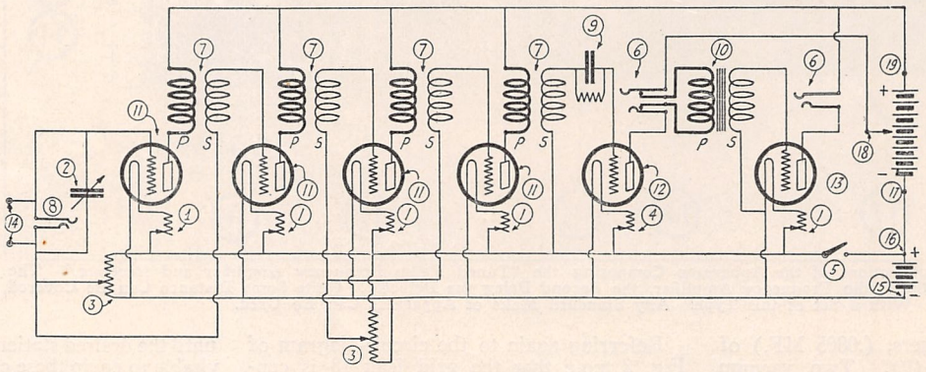


A Rear View of the Four Stage Radio Frequency Amplifier and Receiver Designed and Constructed By Mr. Parkhurst. The Disposition of the Apparatus Is Such That Very Short Leads Are Possible.

RADIO-frequency amplification to the proverbial fourth degree—employing four stages instead of the customary two or three—is effectively represented in a home-made wireless receiving outfit recently assembled by F. A. Parkhurst, a consulting engineer of New York City. Preliminary tests with the apparatus were originally conducted from the fifteenth floor of the Belmont Hotel, New York City, and, subsequently, these experiments were continued from the Powhatan Hotel in Washington, D. C. From these commanding points, by use of a 21" square coil aerial, spiral-wound, radio-telephone signals were audibly received from transmitting stations located in Chicago, Kansas City, Mo., Wichita, Kan., and Atlanta, Ga.

There are four stages of radio-frequency amplification, and one stage of audio-frequency amplification, although the latter unit is not ordinarily put into operation.

The difficulty of controlling the oscillating point of an amplifier circuit employing more than three stages of radio-frequency amplification has discouraged the addition of a fourth unit. In this instance, however, such an obstacle is surmounted by means of two potentiometers by which the grid potential of the radio-frequency tubes is controlled. Also, low plate voltage is used as a means of limiting the amplification in each of the four stages. Sixty-seven and one-half volts are available for the operation of the amplifying tubes and from 18 to 25 volts are used for the detector unit.



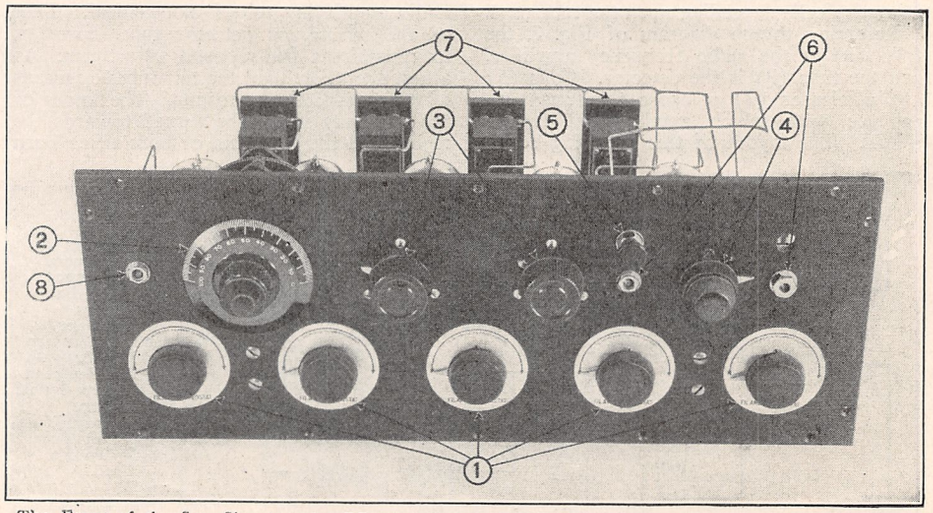
The Complete Circuit Diagram of the Radio Frequency Amplifier and Receiver. Successful Stabilization of the Circuit Is Accomplished By the Use of Two Potentiometers.

A few turns of wire on a frame, resolving itself into a square only 21 inches in dimensions, is another bit of testimony subscribing to the wonder-working feats of the coil or loop antenna. With an electrical circuit of this kind, employing as it does four stages of radio-frequency amplification, the intensity of wireless signals is, of course, greater than the audibility obtained by the use of an overhead antenna and the detector tube alone. Moreover, this circuit, when a loop antenna is employed, limits interference as well as atmospheric disturbances. Of course, the loop antenna is marked by its directional characteristics, thereby being responsive to the reception of wireless signals when pointed in the direction of the transmitting station.

The novice is constantly cautioned to proceed slowly and with more or less depredation when manipulating an amplifier circuit, unless familiar with its parts and the principle of operation. However, Mr. Parkhurst, who devised and assembled this outfit during his vacation period, finds that his wife, unfamiliar with the technical details of the apparatus, has little difficulty in adjusting this wireless receiving set in resonance with a particular broadcasting station and with equal facility "tunes out" the station. However, this outfit, assembled at home during leisure hours, should especially appeal to the "radio amateur," as a model for duplication and operation.

ENGLISH FAN SITS UP ALL NIGHT TO HEAR WGY

An English radio enthusiast who thinks nothing of sitting up until 4 o'clock in the morning to get American broadcasting stations reports receiving the entire program of WGY, the Schenectady, N. Y., station of the General Electric Company, on four different evenings. The most remarkable feature of his reception on a single tube or valve—as the English call them—home-made receiving set. He is J. H. Brittain and he lives at Eccles, Lancashire, England.



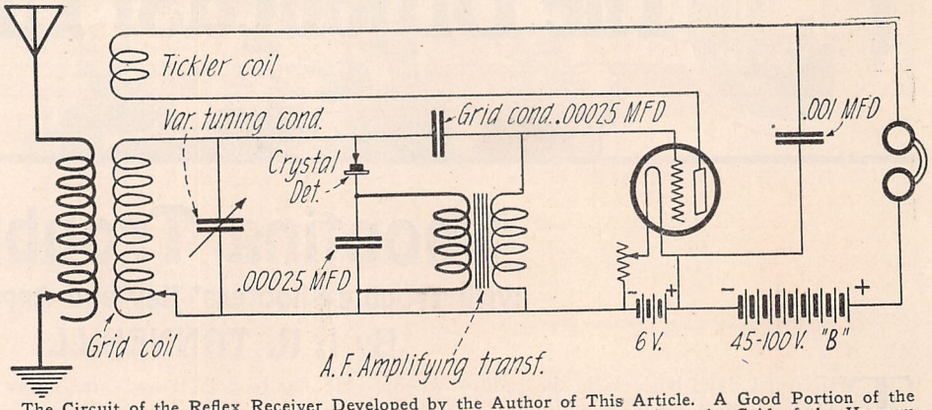
The Front of the Set, Showing the Effective Arrangement of the Controls. The Variable Condenser Knob Accomplishes All of the Necessary Tuning. It Is Equipped With a Vernier, For Fine Adjustment.

Simple Reflex Circuit

By CLYDE J. FITCH

A VERY simple reflex circuit that is especially adapted for broadcast reception is shown in the illustration. This circuit is much simpler than the regular reflex circuit in that it uses less equipment to attain practically the same amplification and in addition is easier to tune. The results obtained from this circuit were made possible by simply combining the regenerative property of a vacuum tube with the detecting property of a sensitive crystal, and then using the same vacuum tube for a one-step audio-frequency amplifier. This circuit has been thoroughly tested and has given excellent results.

Almost any simple one-tube radio receiving set can easily be converted into this simple reflex set by merely adding an audio-frequency amplifying transformer and a crystal detector and making a few minor changes. Much louder signals will be the result, and the additional expense is well worth while. To convert the simple one-tube receiving set into the standard reflex set, a radio-frequency amplifying transformer and a potentiometer will be required in addition to the above equipment; therefore, this simple reflex set is less expensive and easier to construct, and consequently represents a gain in efficiency.



The Circuit of the Reflex Receiver Developed by the Author of This Article. A Good Portion of the Radio Frequency Current Passes the Crystal Detector and is Impressed on the Grid of the Vacuum Tube, Eventually Being Fed Back to the Crystal by the Tickler Coil, Rectified, and Then Amplified At Audio Frequency

The diagram gives practically all of the information required to connect the apparatus. It may be well to mention here that better results are obtained with a double circuit tuner as shown than with a single circuit tuner, due to the fact that the addition of a crystal detector introduces resistance into the circuit, and this resistance tends to decrease the selectivity and thereby makes it difficult or practically impossible to tune out the unwanted stations and still retain the wanted station. As the crystal detector circuit absorbs much of the radio-frequency energy, it is necessary to use a tickler coil that is capable of very close

(*Continued on page* 114)

$225.00 Reflex Prize Contest

WE have always been of the opinion that for clear reception there is nothing superior today to the crystal detector. According to the Bureau of Standards, which we quote as an authority, the crystal detector is the best and most efficient rectifier for radio frequency currents which we know today. It is a wonderful broadcast reproducer.

Of late the Reflex Circuits have come to the fore, and quite deservedly so. Not only do these circuits increase the distance quite a good deal but they accomplish with a minimum number of tubes the same things as a radio and audio frequency amplifier.

Here is something worth while which, however, has not been developed the way it should have been. We have examined and tested many circuits, and while a good many are very good, still there must be some particular circuit that should be even better.

For instance, little has been done with circuits where radio frequency amplification is used in conjunction with a crystal, either in a regular hook-up, as a Reflex, or both. Manifestly there ought to be some way of hooking a crystal detector to a vacuum tube in a circuit that produces better results than anything we know today. That is what we are after—hence this prize contest.

While we state above that this is a Reflex Circuit Contest, we wish to add right here that we do not limit contestants as to this. **The idea behind the contest is to use a crystal detector in connection with a vacuum tube hook-up,** and whether the circuit is really a true Reflex one or not, really does not matter.

What, therefore, is wanted is a combination of a crystal detector with a vacuum tube, and it makes no difference whether the set becomes a regenerative one, a reflex one, or a radio frequency amplifier—or, in fact, any similar combination.

In other words, we want a combination of one—and not more than two crystal detectors, in connection with one—and not more than two vacuum tubes. The judges will award the prizes to the circuits or sets which bring in broadcasting stations from the furthest distances with the least amount of interference.

Other points that the judges will bear in mind are simplicity, originality, and low cost of sets that can be assembled using such circuits.

In publishing the various circuits, all the rights, except patent rights, revert to the publishers. The latter also reserve themselves the right to publish all manuscripts sent in to this contest, although not prize winners. In that case, full space rates will be allowed.

The following prizes will be awarded:

$225.00 In Prizes

First Prize:	$100.00
Second Prize:	50.00
Third Prize:	25.00
Fourth Prize:	20.00
Fifth Prize:	15.00
Sixth Prize:	10.00
Seventh Prize:	5.00

The following rules must be observed:

RULES FOR THE CONTEST

Not more than two crystal detectors and not more than two vacuum tubes may be used in your hook-up. Any kind of crystal detector, and any make of vacuum tube, may be used.

The circuit must be new and different from anything that has appeared in print heretofore—or otherwise some new feature must be embodied in the circuit which was not used or published previously. It is necessary that the circuit must have been actually used, as mere ideas and hook-ups cannot be considered.

As a proof of this, contributors must submit photographs of the outfit in order to compete.

Patented circuits cannot be entered in this contest.

Where standard instruments, such as condensers, tubes, crystal detectors, etc., are used, the make of such instruments should be stated.

A good diagram of the connections, well executed in ink, must be furnished.

A good photograph not smaller than 5" x 7", giving at least two views of the set used in connection with the prize hook-up, is necessary. A photograph of the builder is also required.

All photographs, diagrams, and other data sent in by contestants, which have not been used, may be returned at the publisher's expense.

Where the judges seem to have doubt as to the practicability of the circuit submitted, they reserve the right to call for and inspect and test the circuit used in connection with the entry. Insured Parcel Post charges or Expressage will be at the publishers' expense, both ways. Such sets so called for will be returned promptly to the builders.

More than one hook-up may be entered by contestants. The contest is open to everyone, radio clubs included, except manufacturers of radio apparatus.

Manuscripts accompanying the hook-up, or connections, must not be longer than 1500 words.

Where two contestants submit the same prize-winning idea, identical prizes will be paid to both.

All prizes will be paid upon publication.

This contest closes in New York on Aug. 1st, and the first prize-winning article will appear in the October, 1923, issue.

Address all Manuscripts, Photographs, etc., to *Editor*, REFLEX CONTEST, in care of RADIO NEWS, 53 Park Place, New York City.

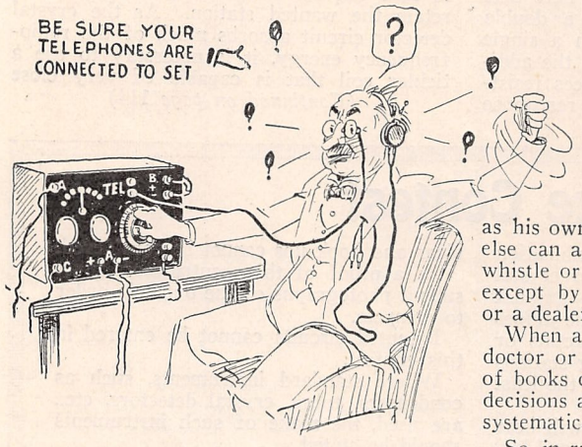
Shooting Trouble

With Trouble-Shooters' Key and Appendix

By I. R. TANNEHILL

THE usual day's business in the radio dealer's shop is about as follows:

An elderly gentleman is looking at the variable condensers. He is thinking of mounting his set on top of a three-quarter-inch oak table and wants a condenser with shaft long enough to mount



the dial above the board and the condenser below. He hears a mushy sound in his telephones, like a cow pulling its foot out of the mud. He wants to know what the cause of it is.

A small boy has 30 cents left for antenna and crystal. He intends to put the aerial 20' high in the back yard and is now getting local stations on the third tap. Where will he hear them with the new antenna? He has been using the bed springs.

A lady, leading a small child by the hand, enters and breaks into the conversation. Her 10-year-old son bought a set here last week and he hasn't heard farther than Pittsburgh, distance 700 miles. Her neighbor hears Los Angeles, distance 2,500 miles, on one bulb with a storage battery, and he says a peanut tube is no good. What is the cause of that awful whistling noise every evening from eight to nine-thirty on three hundred and sixty meters?

While she is talking, the child removes the caps from three storage batteries and drops two cigarette ends into one of the cells.

The day passes in this fashion, the dealer giving out ten dollars' worth of advice and instruction with each ten-cent purchase. The climax is reached when the proud father of the small boy appears and brags about the knowledge of his son concerning radio, admitting freely, however, that he, the father, is not so well informed. His son has sent him for a new what-you-may-call-it for the doojigger. When questioned, he states that the gadget that turns the whiffle-tit on the left-hand side of the box is loose and that the boy asked him to drop in and get a thingembob, you know, one of those round dingbats that sort of grips the dickel-whoop. He finally gets it and goes away satisfied.

This is one of the peculiarities of radio. The telephone company employs experts in communication and a corps of trouble shooters and "hello" girls to assist you in talking to a friend a mile away, but with radio it is different. If father can't assemble the bulbs and sockets and other whatnots in about an hour and establish unbroken communication with a station at least 1,000 miles away, the dealer gets his apparatus back in a hurry.

And after all, these troubles come naturally in an industry that requires every listener to act as his own central and repair staff Where else can a person find out what causes that whistle or grunt or roar or knock in his set except by bothering some other radio fan or a dealer?

When a person attempts to act as his own doctor or lawyer, he secures a book or set of books covering symptoms or practices or decisions and classifies his troubles and goes systematically after the solution.

So, in radio, one must systematize his own trouble shooting activities and profit by his past experiences, properly classified and arranged for ready reference.

As an example, the writer has arranged a key to trouble. The troubles are classified and the causes and remedies are classified. The key is used as follows. Look in the key and locate your trouble by its characteristics. For example, if you hear a popping sound in your detector circuit and said sound is not affected by tuning, you will find it in Division B, subdivision 6, which refers you to the Trouble-shooters Appendix, where, under reference numbers quoted in the key, you will find your trouble and the remedy, unless the remedy is obvious.

As a preliminary precaution, always be sure your antenna and ground are connected, see that your tube is in its socket and lighted, and that your telephones are connected to the set. There is nothing more exasperating than to hunt for trouble for two hours with your set dead and then discover that your phone tips are lying on the floor and had not been connected to the set.

Next, test all batteries and the phones. Noises are not due to battery trouble, but weak signals and dead circuits are usually traceable to battery weakness. Telephones frequently get out of order, usually through an open circuit, and there is no use swearing at the set when it will not produce signals in a pair of dead phones.

Having determined to your entire satisfaction that your trouble is more complex and involved than those mentioned above, proceed to the key. Carefully locate your trouble in the proper classification, and then, having been referred to each of several numbers in the Trouble-shooters' appendix, examine your set in a critical frame of mind and see if one of these references doesn't hit the nail on the head. If it doesn't and you find out what it is, list it and classify it and preserve it for reference.

TROUBLE-SHOOTERS' KEY

A. No signals, no noises. Weak signals, no noises.

a. No signals in detector circuit. No noise. 2, 3, 4, 13, 29, 32, 39, 41.

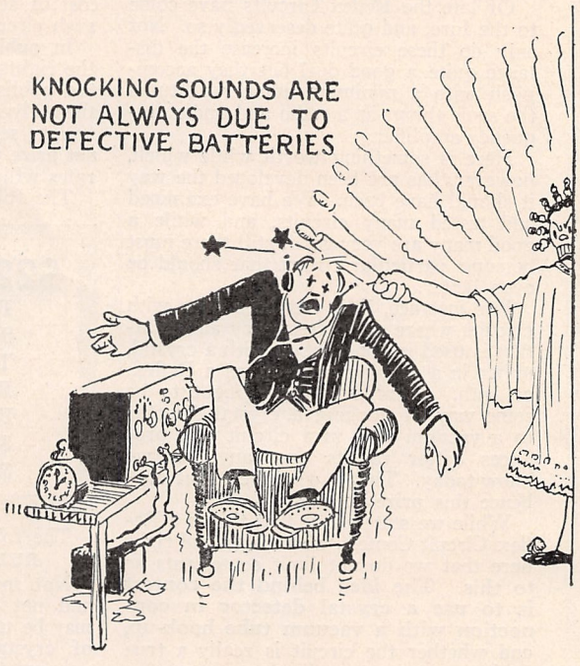
b. Amplifiers dead or weak with good signals in detector. 3, 5, 14, 15, 29.

c. Signals in detector weak. 1, 2, 4, 6, 7, 13, 29, 32, 34, 35.

B. With knocking, scraping, scratching, or popping sounds in the detector circuit.

a. Noises affected by tuning, 9, 17, 18, 21, 25, 26, 30, 31.

b. Noises not affected by tuning. 11, 12, 13, 25, 26, 28, 30, 31, 38, 41.



C. Knocking, scraping, scratching or popping sounds in amplifier circuit, but not in detector. Turn filament of detector off and listen in on amplifiers. If knocking continues it is in the amplifier units. 5, 12, 27, 41.

D. Howls, hisses, squeals, whistles and grunts in detector circuit.

a. That are affected by tuning. 17, 18, 19, 21, 26, 40.

b. That are not affected by tuning. 3, 6, 20, 21, 26.

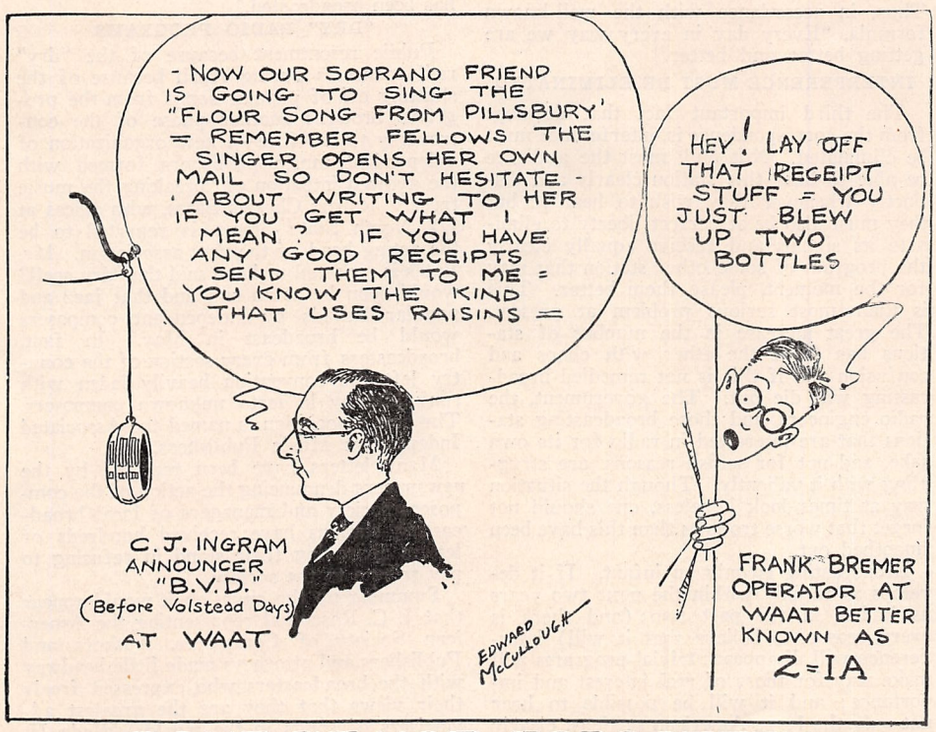
E. Howls, hisses, squeals, whistles, and grunts in amplifiers. 16, 23, 24, 41.

F. Humming or buzzing sounds. 22, 33, 34, 36, 37.

G. Unsteady or wavering signals. 8, 9, 10, 12, 25.

TROUBLE-SHOOTERS' APPENDIX

1. Tickler coil connections reversed, no regeneration; remedy, reverse coil or its leads.
2. Batteries run down.
3. Tube not making proper contact with socket terminals.
4. Polarity of battery reversed.
5. Transformer burned out.
6. Grid condenser shorted.
7. Aerial or ground disconnected.
8. Coils loose and vibrating, causing unsteady signals by varying induction between coils.
9. Too low capacity in antenna, regeneration is difficult to control at extremely low capacities; where 11- or 13-plate condensers are used in antenna and set is unstable, place fixed condenser of capacity .00025 in parallel.
10. Rain causes leaks off aerial, etc., making signals unsteady.
11. Poor connections to aerial or ground.
12. Defective rheostat and unsteady filament current.
13. Telephone windings broken or burned out.
14. Storage battery capable of delivering current to detector tube, but drain on battery from amplifiers is sufficient to reduce voltage on detector filament below critical point.
15. Lighting amplifier tubes, after adjusting detector, throws detector tube out of adjustment when operated on same battery; always tune in on detector with amplifiers lighted, if same battery is used.
16. Primary of transformer reversed.
17. Too much "B" battery voltage on detector plate.
18. Too much inductance in tickler coil.
19. Too high grid leak resistance.
20. Plate leads touching grid condenser or its leads or near them.
21. Excessive detector filament voltage.
22. Ground and plate leads parallel and close together.
23. Cause of howling in stages in excess of two is difficult to assign. Good remedy is placing of fixed condenser of capacity .001 across secondary of last transformer.
24. Transformers too close together.
25. Tube oscillating intermittently due to poor connections to antenna or ground. This is often a difficult trouble to locate. When the antenna or ground (whichever connection is defective) is removed, the noise ceases, leading the operator to believe that the noise comes from without. As a matter of fact, the breaking of his antenna or ground connection through poor contact changes his wave-length intermittently and the set ceases to oscillate and then breaks over again with a popping or knocking sound.
26. Excessive grid charge. Detector tube paralyzed. This may result in a howl of any pitch from a shrill whistle down to a slow knocking sound, at intervals of 10 to 20 per second, depending upon time interval of recovery and paralysis. Remedy, decrease filament voltage, loosen tickler coupling, or decrease plate inductance and lower the grid leak resistance.
27. Moisture in transformer shorting between turns or layers. In this case the noise may be heard with primary of transformer, telephones and battery in series. Remedy, place transformer in oven and dry out at moderately high temperature and impregnate with paraffin.
28. Plate and grid coil leads interchanged, with "B" battery shorted to negative filament. This produces a terrific knocking.
29. Phone condenser shorted.
30. Dust, etc., between plates of variable condenser. When the antenna condenser is shorted, a knock or click occurs as the train of oscillations in receiver is stopped with increase of wave-length.
31. Getting fingers against metal parts connected to oscillating circuit while tuning.
32. Primary circuit not tuned.
33. Grid condenser on bottom of cabinet or resting on table may pick up vibrations or hum from light circuit.
34. Grid coil disconnected.
35. Tube oscillating below critical filament temperature. It is often the case (more frequently than generally supposed) that weak signals are due to the set oscillating below critical filament temperature, thus making it necessary to reduce the temperature too low in order to clear the signals. Some tubes oscillate much more readily than others. This condition is proved by increasing temperature above oscillating point when signals will increase in audibility, but become more and more distorted. Remedy, less plate inductance, less "B" battery, higher antenna capacity, lower phone by-pass capacity.
36. The majority of humming sounds originate in the plate circuit and are caused by using hook-ups where the plate is directly connected to aerial or by a faulty connection causing leaks from plate circuit to ground. Where a very close coupling is necessary between plate and grid coils to produce maximum regeneration humming sounds are more pronounced.
37. After charging storage battery from a home charger, a decided hum is picked up from light circuit if the charging leads remain connected to battery.
38. Knocking sounds that cannot be tuned out and that are not received with antenna and ground disconnected are usually static. Remedy, commit suicide.
39. Bank wound coils made at home are often improperly wound and are frequently absolutely dead in the receiving circuit. Do not use home-made bank wound coils unless you understand method of winding.
40. Steady whistling notes that disappear but do not change pitch with tuning are due either to two broadcasters on the same wave or to your neighbor listening in to rotten music with his set oscillating. Remedy, go over to his house and offer to show him how to tune his set and get kicked out. Otherwise you can substitute a 5-watt tube for your detector, put 100 volts on the plate and tune in on the same station with your set oscillating, and slightly out of phase. This will discourage him in about five minutes and he will listen to something else.
41. Poor connections and worn apparatus in general. Occasionally it is well to pull the set apart and rewire it. The results are sometimes surprising.



GONE BUT NOT FORGOTTEN
STATION WAAT OF THE JERSEY REVIEW, J.C. N.J.
THE PIONEER NEWSPAPER STATION OF THE EAST

GENERAL ELECTRIC CO. TO INSTALL TWO MORE BROADCASTING STATIONS

Plans are nearing completion for the erection of two more giant radio broadcasting stations by the General Electric Company, according to an announcement recently made by Martin P. Rice, director of broadcasting for that company.

One of the new stations will be located near San Francisco and the other is indefinitely placed at somewhere between the Pacific and Atlantic Coasts. Both will be modeled after General Electric Company station WGY at Schenectady, N. Y., and the experience gained by the engineers in this station, after fourteen months' operation, will aid greatly in the plans to give radio listeners in other parts of the country a radio service of the highest transmission quality.

Mr. Rice recently returned from the coast after a tour of inspection. He was accompanied by Harry Sadenwater, engineer in charge of the technical operation of General Electric Company radio broadcasting stations. Sites were investigated in and near Oakland and San Francisco, Cal., in Denver, Colo., and Dallas, Texas.

In each city visited, Mr. Rice received assurance of co-operation from the chamber of commerce and municipal officials, who were alive to the advantages and prestige which may accrue to the city which is the home of a powerful broadcasting station.

The expansion of radio broadcasting by the General Electric Company from one to three stations is part of program agreed upon some time ago by the General Electric Company, the Radio Corporation of Amer-

(*Continued on page* 96)

What the Radio Audience Tells Us

By WILLIAM H. EASTON*

There Are Fair Radio Listeners On the Other Side of the Pacific As Proven By the Cover Of Our Japanese Contemporary, the .....(See Name On Top). From the Expression On Her Face, One May Easily Imagine How Wonderful She Thinks Radio Is. "Oh My!" Says She.

IF the radio audience could realize some of the problems that have to be solved by those who are engaged in preparing the programs, they would, I am sure, not only sympathize with them but would wonder how they preserve their sanity. No one before has ever had to entertain a million or so people every night; and consequently those who have undertaken this simple little task have had to stumble along as best they could learning as they went and profiting wherever possible by their mistakes. They are, however, exceedingly fortunate in having an audience that tells them frankly just what it thinks about their efforts; and with the hundreds of letters that reach them daily as a guide they have been able to work with some degree of certainty.

The first rule that the letters lay down is: Give the radio public infinite variety. If you were to open their mail some morning, the first letter would probably say, "I enjoyed your concert so much last night. That's right; give us more good music and do away with those execrable popular selections." Then the second letter would say, "For the love of Mike, cut out the Up-Roar and give us good old American Jazz." Letter number three would read as follows: "Prof. Simpkins' address on the Color of Cats was the most interesting speech I ever listened to"; and letter number four would state, "Why do you inflict your audience with such stupid stuff as the talk on cats? I hung up my receiver in disgust."

With testimony like this it is quite evident that it is very difficult to satisfy everybody all the time. The only thing to be done, is to draw from the entire field of music, literature, science, politics, culture, hygiene, and religion, and thus please everyone at least part of the time. Consequently, those who do not like jazz music must bear in mind that many will listen to nothing else; while those who do not like speeches must remember that a very large number of radio listeners are isolated or are invalids, and absolutely depend upon radio for their contact with the outside world.

CONSTANT IMPROVEMENTS NECESSARY

The second point that the letters prove is, there must be constant improvement in broadcasting both technically and artistically. No station can maintain its programs on a dead level and retain the interest of its audience. The complaints soon begin to come in. Curiously enough, they are all to the effect that the programs are getting very poor. This is not the case. They are just as good as ever; but the taste of the audience has improved. It is for this reason that KDKA is experimenting so constantly in every direction. Its engineers are incessantly striving for better tone reproduction and for the elimination of unpleasant noises. Its program staff is incessantly working for better artistic effects and for entirely new features. They began with the phonograph; then introduced artists and speakers in person; then went outside of the studio for church services, important meetings, symphony concerts, operas, and sporting events; and recently established an orchestra so that incidental music could be rendered in the best possible manner. Thus, in accordance with the well-known formula, "Every day in every way we are getting better and better."

INTERFERENCE MUST BE ELIMINATED

The third important fact that develops from the correspondence is, interference must be eliminated. Not only must the audience be able to hear this station clearly and distinctly whenever they wish to hear it, but they must also be at perfect liberty to eliminate its signals and receive equally clearly the program of some other station that may for the moment, please them better. This is their most serious problem at present. The great increase in the number of stations has filled the ether with chaos and confusion and if this is not remedied broadcasting will die out. The government, the radio engineers, and those broadcasting stations that are interested in radio for its own sake, and not for selfish reasons, are struggling with it valiently. Though the situation may at times look hopeless, one should not forget that worse troubles than this have been smoothed out.

Broadcasting is only an infant. If it develops as rapidly within the next two years as it has in the past two (and there is every reason to believe that it will) interference will disappear; trivial programs will make way for those of real interest and importance; and it will be possible to hear not only the large American stations, clearly and distinctly, almost anywhere in the United States, but stations in London, Paris and Rome as well.

Westinghouse Electric & Mfg. Co.

RADIO BROADCASTERS OPPOSE PUBLISHERS

By ROSCOE SMITH

The fight to bring back popular music to radio was crystallized into organized action at Chicago in the last week of April when broadcasters representing Chicago and twelve surrounding states formed the National Association of Broadcasters.

The problem raised by the American Society of Composers, Authors and Publishers when that association demanded a license fee or royalty, from broadcasters for the use of song "hits" rested mainly on the contention of the composers and publishers that radio broadcasting has reduced the sale of sheet music, player piano rolls and phonograph records. These products of inspiration and mechanical devices, they claim, are their only source of profit and broadcasters were served with warnings that unless they paid license or royalty they would face suit for damages for violation of the copyright laws if any music controlled by the society was broadcast by radio.

Out of several hundred broadcasting stations only two indicated any desire to comply with the dictum of the composers and publishers and practically all of the stations placed a ban on music controlled by the society.

Surprise was manifested by some of the broadcasters over the action of the composers and publishers because of ample evidence in hand that radio has popularized many songs and thereby created a heavy demand for such selections. It is claimed that radio stations reach a far greater audience than the old-time vaudeville and five-and-ten-cent-store "song pluggers."

Thorne Donnelly, program director of the Chicago Board of Trade station WDAP at the Drake Hotel was emphatic in his belief that radio has boomed old and new song creations. A careful canvass among dealers in sheet music and phonograph records disclosed the fact that radio has increased sales and that the music most in demand is that which has been broadcasted.

"DRY" RADIO PROGRAMS

Public resentment because of the "dry" radio concerts during April because of the shutting off of popular songs from the programs brought another phase of the controversy to the fore—a new organization of independent music publishers formed with the avowed intention of "breaking the music trust." Robert Charles Bates, with offices at 177 North State Street, is reported to be the acting head of the new association. Mr. Bates is reported to have said the "dry spell" would soon be at an end and that jazz and popular ballads by independent composers would be broadcast in May. In fact, broadcasters from every section of the country left the convention heavily laden with song hits by hitherto unknown composers. The new association is named the Associated Independent Music Publishers.

Many letters have been received by the newspapers denouncing the action of the composers society and managers of local broadcasting stations have received hundreds of letters approving their stand in refusing to pay tribute to the society.

Summing up the situation it would appear that J. C. Rosenthal representing the American Society of Composers, Authors and Publishers and attorneys made little headway with the broadcasters who expressed freely their views that they are the greatest advertisers of songs in the world. Wade H. Wade, of the Wade-Twitchell Company, stated that the sale of phonograph instru-

(*Continued on page* 99)

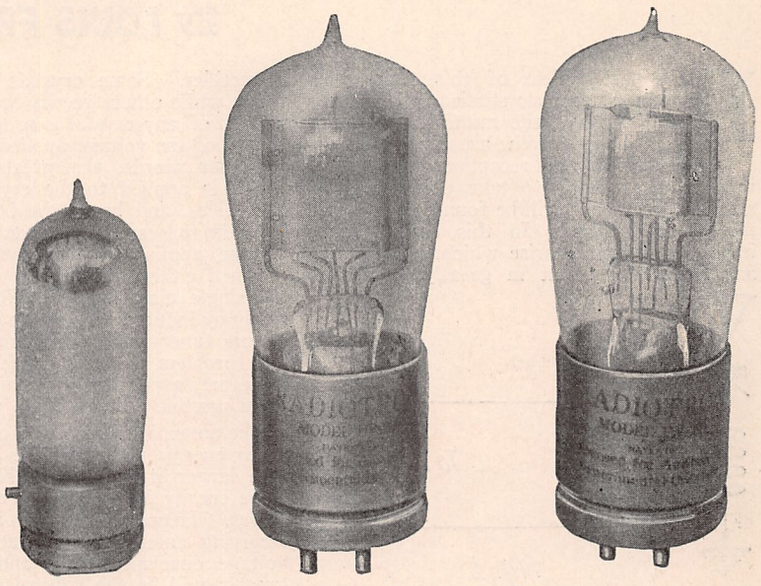
New Development In Tubes

A RADIO tube which consumes 70 per cent less current than any of the small or so-called peanut variety now being sold and the first to operate with the filament current supplied from the ordinary flashlight battery has been perfected by the General Electric Company. It will be known as the UV-199.

This new type radiotron has the X-L tungsten filament, which according to radio engineers is considered as great an advance over the old tungsten filament for vacuum tubes in radio work as the tungsten incandescent lamp is over the carbon lamp in the field of electrical illumination.

The filament wire in the new tube is extremely small, being but one-fourth the diameter of an ordinary hair. However, this is not an indication of any weakness, for this tungsten wire has the strength of the best steel piano wire. By radio engineers, this new filament is considered practically ideal.

This new tungsten filament has the high efficiency of electron production of the coated filament and the uniformity of operation and ruggedness of the tungsten filament. It has the quietness of operation and length of the coated filament and a lower operating temperature and longer life than the old tungsten filament.



In This Picture Are Shown the New Tubes Compared to a Standard One. Note the Size of the UV-199 and the Dimensions of the Plate of the UV-201A As Compared to the UV-201. The C-301A Is Similar to the UV-201A.

© *R. C. A.*

HEATING CURRENT IS SMALL

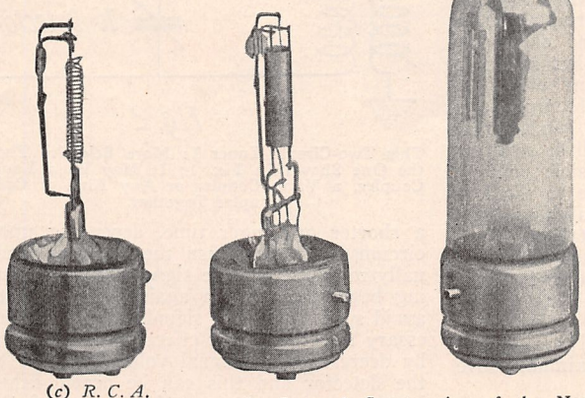
The wattage consumed by the filament of this tube is .18, or approximately but 1/27 of the energy used in the UV-201 tube. Yet the characteristics when used in a radio set are slightly better.

The filament of this tube runs at a temperature about 400 degrees cooler than the old type of Radiotron tube.

It is interesting to note that 14 different chemical elements are utilized in this tube besides traces of several others.

This Radiotron might almost be termed "the tube with nine lives" because if the filament is operated at too high a temperature the electron emission falls off and the tube becomes inoperative. However, by operation at rated voltage with the plate voltage off for a period of time normal electron emission can be regained.

The chemical structure of the filament is responsible for this improvement. When heated by the current passing through it, the filament undergoes a chemical change which causes a layer of pure thorium to be formed on the outside of the filament. This layer is one atom deep and supplies the electrons necessary to the functioning of the tube. Inside of the filament, just under this layer, more thorium atoms are deposited, being drawn from the inside of the filament slowly. If the filament is heated too much, the thorium layer vaporizes as well as the supply immediately under it and no more electrons are emitted. It is, therefore, necessary to reform the layer and thorium supply to heat the filament at normal temperature for a length of time, depending upon the excessive temperature at which the filament was run. In a word, if the filament temperature is too high, the supply of thorium which produces the electron is less than the consumed amount. If 10 volts are applied on the filament of a UV-199 tube for about two seconds, it takes about one-half hour to bring the filament back to its normal state of operation. If the overload is applied for 10 seconds, a few hours may be required to obtain the same result.



(c) *R. C. A.*

These Photographs Show the Internal Construction of the New UV-199 Tubes. On Account of Their Small Size the Grid and Plate Have Small Capacity Which Makes the Tube More Efficient For Radio Frequency Amplification.

GOOD FOR RADIO FREQUENCY

This new Radiotron tube is an excellent radio-frequency amplifier, because the capacity between elements is lower than that of the UV-201-A tube.

Although the base of this tube is of the same general design as the standard four-prong base, it is of smaller diameter and the arrangement of the leads to the contact pins is different, the grid and plate contact pins being opposite rather than adjacent. This has been done to facilitate wiring and simplify connections in a multi-tube set.

This tube operates satisfactorily in all circuits which were used with the old UV-201 tube and should give slightly superior results, especially in radio-frequency amplification. Constant voltage operation of the filament is recommended. However, constant current operation does not entail the serious loss of tube life that followed constant current operation in the old tungsten filaments.

Work on this new tungsten filament in the new tube has been going on in the research laboratory of the General Electric Company for more than eight years.

The UV-199 tube requires so little filament energy that the ordinary No. 6 dry cells give remarkably long service. For instance, three No. 6 dry cells in series will operate one of the UV-199 tubes one hour a day for a whole year; or will operate two hours a day over the entire "radio season." This is a very advantageous feature, because it allows dealers to equip sets in the beginning of the season with batteries which with ordinary and intelligent use will last the entire active part of the season.

On a three-tube set three No. 6 dry cells will operate the tubes one hour per day for a period of over four months.

In the case of portable sets using three-cell flashlight batteries, it is recommended that one set of three flashlight cells be used for each tube in the set. It is immaterial whether each tube is wired separately to one of the batteries or whether they are all placed in parallel, provided separate rheostat control is made for each tube. If separate rheostat control is not employed for each tube and only a common rheostat provided, the batteries should be connected in parallel.

PROPER GRID BIAS MUST BE USED

In common with all receiving tubes, there are certain precautions which should be observed in order to obtain satisfactory results.

The proper grid bias must be used, depending in amount upon the plate voltage employed. Under certain conditions of small interference, slight static and weak signals, a grid leak resistance as high as six to ten megohms can be employed with success. With strong signals and heavy interference or static, a lower grid leak resistance down to possibly two megohms should be used.

It should be understood that this UV-199 tube will not deliver the energy as an amplifier that the UV-201-A will. The UV-201-A is a remarkably powerful tube and has electron emission, mutual conductance and amplification far above any other receiving tube. It must not be expected that with a filament expenditure of only .18 watt that as powerful results can be obtained on an amplifier as with the expenditure of 1.25 watts.

On account of the low filament current required by this tube, it is essential to have the filament rheostat of sufficient resistance. For operation from three dry cells, the filament rheostat resistance should be at least

(*Continued on page* 99)

The Antenna and Its Relation To Detection Efficiency

By LOUIS FRANK

IN the last article of this series the antenna system was studied in complete detail. Any of the multiple wire antennae there given are suitable for transmission and reception. However, if only reception is to take place, then a single wire antenna will be found to be completely satisfactory. In this case certain important questions arise which, if properly answered, will result in greatly improved

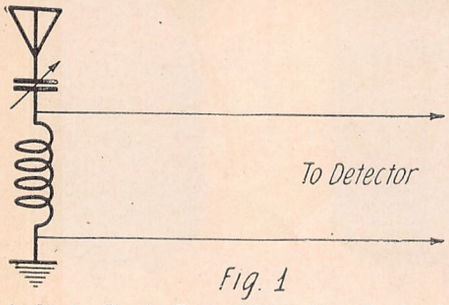


Fig. 1

A Single Circuit Tuner Which May Be Used With Any Type Of Detector.

reception under the various conditions and circumstances which arise in radio reception. Such questions are: How long and high should the antenna be made when employing crystal detectors? How long and how high when employing non-regenerative tube detectors? How long and how high when employing regenerative single circuit tuners, and when employing regenerative double circuit tuners? Can the antenna ever be made short and low without sacrificing detection efficiency, and, if so, when? What are the requirements for good detection when employing crystal detectors or non-regenerative tube detectors, and when employing regenerative tube detectors? These questions are the heart of the reception problem. Most amateurs think that it is always essential to make the receiving antenna as high and as long as possible. This notion is erroneous and would not be so prevalent if the relationship between antenna height and detection efficiency were thoroughly understood. This article will, therefore, be devoted to an explanation of this matter.

OBTAINING LOUD SIGNALS

In radio reception the condition aimed for is to receive the signal as loudly as possible. Especially is this the case when receiving broadcast entertainments, for it is often desired to entertain a roomful of people. Now the loudness with which the transmitted signal is received depends upon the efficiency of the detector, the efficiency of the tuner and the antenna. Naturally, the more efficient the tuner is, the louder will the received signal be, but the efficiency of the tuner is entirely a matter of the proper design of the tuner, and this will not be considered here, as it is a large subject in itself. This will be taken up in a later article. We are at present concerned solely with the antenna and detector. Now the efficiency of the antenna was considered in detail in the previous article of this series and methods were given for eliminating wasteful losses and increasing efficiency. We must, therefore, consider here the specific problem of the relationship of the antenna to detection efficiency. The efficiency of the detector depends upon conditions which differ for different detectors, but in all cases the detector efficiency depends upon the signal voltage applied to the detector. Let us consider each detector separately.

CRYSTAL DETECTOR

In the case of the crystal detector the efficiency depends upon the extent to which it rectifies. Some crystals rectify imperfectly while others rectify well. The rectification of any crystal is proportional to the square of the voltage applied to the crystal. In other words, the greater the voltage which is applied to the crystal, the better it rectifies, and hence the better it detects. Now in the case of a crystal receiver, the voltage applied to the crystal detector is obtained either directly, as in the case of the single circuit tuner (Fig. 1), or indirectly by induction, as in the case of the two circuit tuner (Fig. 2), from the antenna. The problem of most efficient detection is, therefore, a problem in obtaining the maximum possible voltage from the antenna.

The antenna is the means of collecting the radio energy which travels through space. The larger it is and the higher it is, the more energy it extracts from passing radio waves. Hence the longer and higher the receiving antenna, the greater will be the voltage developed in it, and therefore the greater will be the voltage transferred and applied to the crystal detector. In the case of crystal receivers, therefore, maximum detection efficiency will be secured with long and high antennae; the longer and higher, the better. The object of height in the antenna is largely to overcome absorption effects of structures around it, for if the antenna is too low, much of the energy in the passing wave trains will be absorbed by the surrounding structures and so fail to act on the antenna. If the antenna is made higher than the surrounding structures, this disadvantage is avoided. The object of length in the antenna is to collect as much of the energy from the passing waves as possible. The length cannot be made too great, however, for then the fundamental wave-length of the antenna will be so great that sharp tuning will be impossible; in fact, it may not be possible to tune to the low broadcasting wave-lengths at all then. So that in tuners employing crystal detectors, maximum results will be obtained with long and high antennae. Good, practical values are about 100′ to 150′ long (it is not necessary to go beyond 150′) and as high as conditions permit, which generally is in the neighborhood of 50′ or 60′ maximum above ground.

The non-regenerative tube detector is also a "voltage operated device," that is, its response is directly proportional to the voltage which is applied to the grid of the detector tube. The voltage applied thus is the signal voltage, and the magnitude of the signal voltage depends upon the received current in the antenna. This depends upon the size of the antenna, the longer and higher the antenna, the greater the voltage. Thus for non-regenerative tube sets, the antenna should be constructed to have great length and height, as for the crystal tube sets.

COUPLED CIRCUITS ARE MORE EFFICIENT

When using a single circuit set as in Fig. 1, the voltage which is applied to the detector, crystal or tube, is the voltage direct from the antenna. However, when using a double circuit set employing a loose coupler or variocoupler arrangement, as in Fig. 2, the voltage applied to the detector is obtained by induction from the antenna primary circuit. Now in this case the virtue of this arrangement is that it enables the operator to adjust the intensity of the signal voltage which is applied to his detector. By properly proportioning his primary and secondary he can so arrange the set that the transfer of energy from primary to secondary is accompanied by a rise in the voltage. Further adjustment can be secured by increasing or decreasing the coupling between primary and secondary until the signal of the proper strength is secured.

The above arrangement will be found to be very important at times, especially in reducing the signal voltage applied to the detector. It sometimes is necessary to reduce rather than increase the signal voltage applied to crystal or non-regenerative tube detector. This will be clear from the following phenomenon which the reader has probably often observed. While listening to the broadcast entertainments he has heard a sudden loud signal interfere with the concert or speech, after which the concert or speech was no longer heard. Then after a short while, if he has left his adjustments as they were, the concert or speech gradually b gins to come in faintly, slowly increasing to normal intensity. The sudden loud signal was due to a very powerful signal voltage, probably from some powerful spark transmitter or transmitter very close to the receiver. Now, when an excessive voltage strikes a detector tube or crystal it paralyzes the detector and prevents it from operating. This paralyzing action lasts for a shorter or longer time, depending upon circumstances, and then the detector gradually recovers, and the signals or broadcasting begin to come in again. In order to avoid such paralyzing signals it may be necessary to reduce their effect on the detector by decreasing the signal voltage applied to the detector and this can be accomplished by the two-circuit tuner by means of the coupling arrangement. By loosening the coupling the voltage induced from antenna

(Continued on page 98)

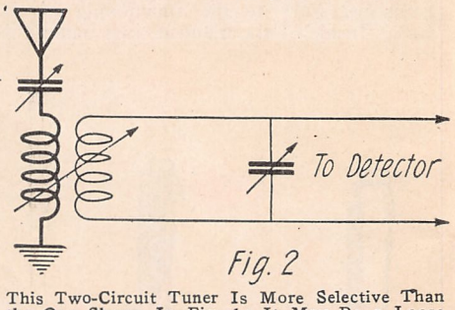


Fig. 2

This Two-Circuit Tuner Is More Selective Than the One Shown In Fig. 1; It May Be a Loose Coupler, a Vario Coupler or Any Kind of Coils Coupled Together.

List of interesting articles appearing in the July issue of Practical Electrics

Electric Fountain of Youth
By Clyde J. Fitch

Ford Coil Buzzer

My Wakeful Bedfellow
By M. McCabe

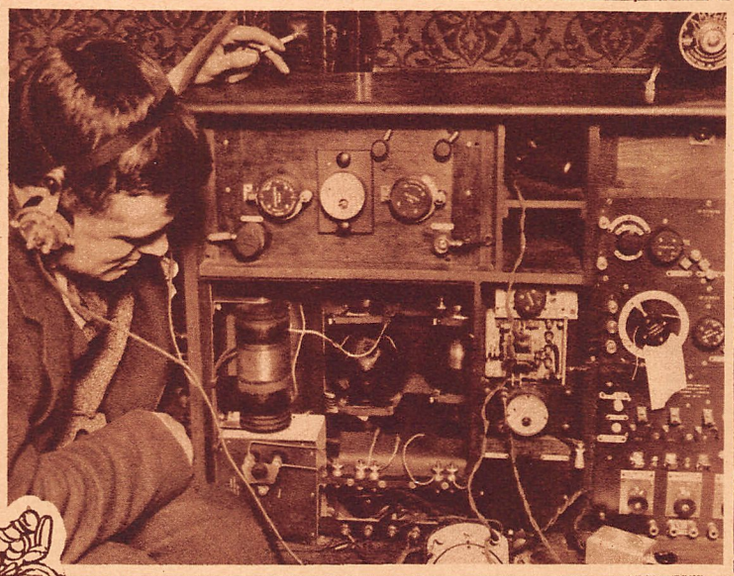
Motor Driven Furnace Control

Electric Thread Gauge

Repairman's Test Panel

Determining Moisture
By George J. McVicker

Radio In England



Evidently, Following the Numerous Tests Made in the United States of Radio Receiving Apparatus on Moving Trains, the English Have Fitted the "Grand National Special" Throughout with Radio. Each Compartment Has a Loud-Speaker, the Receiving Set Being in a Separate Compartment at the Rear of the Train. Concerts Are Picked Up from London, Manchester and Birmingham During the Journey. The Photo Shows the Operator in Charge of the Receiving Set, at Work.
© *Wide World Photos.*

Professor Low, One of England's Greatest Scientists, in the Act of Broadcasting His Lecture "The World 100 Years Hence," from the English Broadcasting Station 2LO. Note the Peculiar Construction of the Microphone.
© *Wide World Photos.*

The Reproduction of a Cover of RADIO NEWS, Used Some Time Ago, May Suggest Foresight, or Just Pot-Luck, When Placed Alongside the Above Picture. However, at the Time, This Cover Typified Our Prediction of What the Future of Radio Might Bring. The Picture Above is an Honest-to-Goodness Radio Organ, Which Recently Appeared on the Streets of London. This Hurdy Gurdy Contains a Four-Tube Receiving Set. Two Loud-Speakers Are Used, Which Produce Enough Volume to Be Heard 200 Yards Away.
© *K. & H.*

RADIO

©K & H

To the left is a photo of an "unofficial receiving set, built aboard the U. S. S. *Maryland*. Connected to the auxiliary antenna of this man-of-war, it has provided diversion for the entire crew. WJZ was picked up while in the Canal Zone. The crew of the submarine S-50, rather than spend their time below, have equipped a loud-speaker on deck of their craft, which is connected to the submarine's receiving set. From the photo in the lower left-hand corner, it is evident that they are enjoying themselves. The photo below will illustrate the effectiveness of radio advertising. With the aid of a sensitive radio receiving set, the New York National Guard started a drive for recruits. The apparatus was situated in Herald Square, New York City. The attractive force of the radio is evidenced by the crowd standing by.

Here is another point in favor of radio. Millions of people can listen to the voice of one person It virtually roars around the

©P & A

© *Fotograms, N. Y.*

New Wave-Lengths

TO clear up the congestion in radio broadcasting, a new schedule of wave-lengths, which went into effect on May 15, went out on April 19 from the Department of Commerce, which has been working on the problem ever since the recent National Radio Conference.

Definite wave-lengths have been allocated to each of five zones into which the country has been divided, and broadcasting stations will have to adhere to these or else suffer the penalty of loss or suspension of license.

For the Class B stations (the high-power transmitting agencies) there will be ten wave-lengths in each zone, and all of these will be adjusted so as not to conflict with any other.

Of the ten zone lengths assigned to Zone 1, which extends from New England through the District of Columbia, three of them, 405, 455 and 492 meters, have been assigned to New York City and Newark. This is because so many persons are served by the stations in the neighborhood, and so much entertainment talent is available. The stations in New York and Newark will have to arrange for division of time.

Other assignments of wave-lengths thus far in this zone are:

Springfield, Mass. (Westinghouse station) and Wellesley Hills, Mass., 337 meters.

Schenectady (General Electric), and Troy (Renssalaer Polytechnic), 380 meters; Philadelphia (Wanamaker's, Lit's, Strawbridge & Clothier), 509 and 395 meters, and Washington (Arlington and Radio Corporation), 435 meters. It is likely that Arlington will have a special wave-length and not be forced to divide time with any other station. Wave-lengths of 303, 319, 469 meters also are reserved for this zone.

Assignments in the other zones up to this time are:

Zone 2—Pittsburgh, 326; Chicago, 448; Davenport and Des Moines, 484; Detroit and Dearborn, 517; Cleveland and Toledo, 390; Cincinnati, 309; Madison and Minneapolis, 417.

Zone 3—Atlanta, 429; Louisville, 400; Memphis, 500; St. Louis, 546.

Zone 4—Lincoln, Neb., 341; Kansas City, 411; Jefferson City, 441; Dallas and Fort Worth, 476; San Antonio, 385; Denver, 323; Omaha, 527.

Zone 5—Seattle, 492; Portland, 455; Salt Lake City, 312; San Francisco, 509 and 423; Los Angeles, 395 and 469; San Diego, 536.

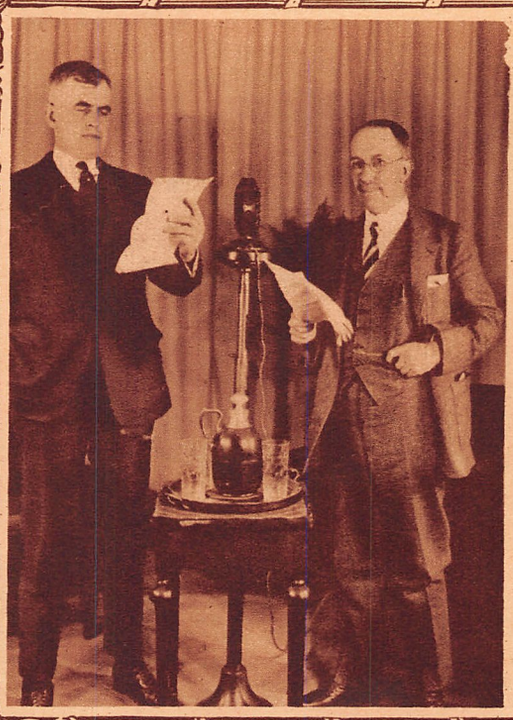
None of the wave-lengths go above 600 meters. This is important to amateurs, as according to a plan proposed to the recent conference, the large stations might have had wave-lengths up to 700 meters, which would have necessitated the changing over of many receiving sets.

Besides the Class B stations, which broadcast to long distances, there are 540 Class A stations which use the 360 meter wave-

REVIEW

radio earth. To the right is a photo of Ransom H. Gilett (con) and Wayne B. Wheeler (pro) at Station WEAF, who recently debated on the question of the Eighteenth Amendment. Their speeches were heard over a good portion of the United States, and there is no doubt but that their words set the minds of many on the subject of prohibition.

There is shown, directly below, a four-tube portable receiving set, the aerial for which is included on the rear panel. This outfit is capable of long-distance reception. The greatest evidence as to what radio can and may do is gleaned from the lower photograph. This shows the students in the Haaren High School of New York receiving their lessons over the radio. Accounting problems were given, and each pupil worked an adding-machine, simultaneously with the announcement. Yes, the radio age has commenced.



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Are Assigned

length. These will be allowed to retain that wave-length or can come into a special band between 222 and 300 meters. If a new station is erected and it can not meet the qualifications of a Class B station it will not be allowed to use 360 meters, but must go into the 222-300 band.

Because of the great activity in radio, the Department of Commerce is enlarging its forces in the inspection districts of which there are nine with Boston, New York, Baltimore, Atlanta, New Orleans, San Francisco, Seattle, Detroit and Chicago as headquarters.

Beginning May 15, inspectors will check the wave-lengths of stations in their districts.

It was stated that any station now operating on 360 meters has the privilege of remaining on that wave-length. It is also emphasized that the assignments of wave-lengths are for cities and not for specific stations.

IGNORE RADIO MUSIC TAX

Following conferences among managers of radio broadcasting stations concerning the demands made for royalties on all copyrighted music controlled by the American Society of Composers, Authors and Publishers, it was announced on behalf of some of them that this proposed tax would be ignored and that sending might be continued as usual unless court action should intervene.

The Radio Broadcasting Society contends its members are performing a public service without profit, and that therefore copyrights are not infringed.

"In moving picture theatres, cabarets and other public places conducted for profit, we understand that copyright holders are exacting, or will demand, two cents for each seat where this music is presented," said an official. "At first the suggestion was made that we pay a similar fee, which might mean that we would be taxed on 200,000 or more persons. The present proposals that we pay fees of $200 to $5,000 yearly are equally out of the question for a non-commercial form of broadcasting."

BROADCASTING CHANGES AT CHICAGO

By ROSCOE SMITH

A new broadcasting station, with a number of novel features for such an enterprise, will soon make its bow to Middle West radio fans. The station will be located at the Edgewater Beach Hotel.

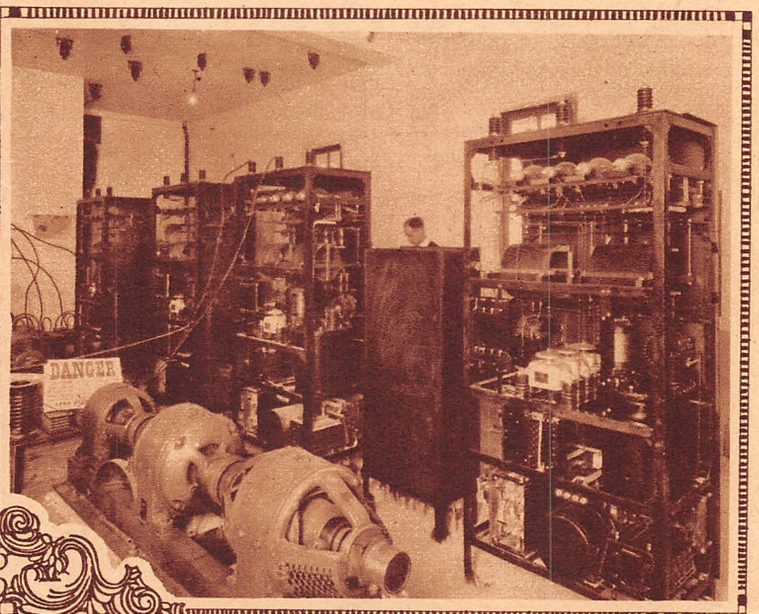
Mr. McDonald, owner of the new station, said it was his intention to make the station the show place of radio broadcasting stations in Chicago. The station will be on the main floor of the Edgewater Hotel occupying the northwest wing of the building. Through the windows it will be visible to those on the walk, and from the inside it will be fully visible, the entire studio being enclosed in three thicknesses of plate glass with four-inch spaces between each thickness, so that the public may walk around and see the station in full operation from every angle.

(*Continued on page 62*)

Radio Pictorial

©K & H

Above: S. L. Rothafel, Director of the Capitol Theatre in New York City, is His Own Announcer. Right: Transmitting Apparatus of the New Station in the Aeolian Building, New York City. Programs Are to be Simultaneously Transmitted on 405 and 455 Meters.



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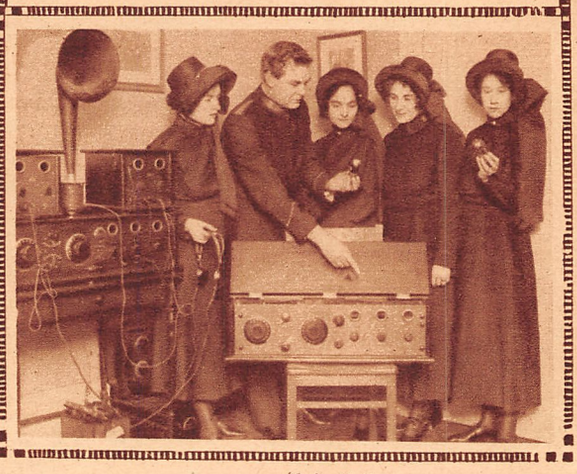

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Left: The Big Four of the Second National Conference on Radio, Recently Held at Washington, D. C. From Left to Right Are: W. D. Terrell, Chief of Radio Inspection of the Department of Commerce, Dr. J. H. Dillinger, Chief of the Radio Laboratory, Bureau of Standards, D. B. Carson, Commissioner of Navigation, and L. E. Whittemore, Bureau of Standards. Right: Brig. William Palmer, of the Salvation Army, Giving Instructions on the Care and Operation of Radio Sets to a Class of Salvation Army Lassies, Who Are to Be Assigned as Teachers in Radio at the Various Salvation Army Posts.

Wave-Lengths for Class A Stations Being Assigned

SIX Class A stations, the first of the newly classified broadcasters, were licensed during the past week by the Radio Section of the Department of Commerce. Texas, Oklahoma, Illinois, Pennsylvania, Louisiana and Indiana each received one station with a wave-length exclusive for its respective district.

From the schedule of wave-lengths for Class A stations, printed below, it will be seen that at least 20 distinct wave-lengths in each of the nine radio districts are available for distribution by the local inspectors. Three or four wave-lengths in each district will be reserved for the best of the local stations of this class, these waves not being assigned to stations in the immediately adjoining districts. This gives the better of the A broadcasters a partially exclusive transmitting wave. For example, the wave-length 222 meters may be assigned to stations only in the 4th, 5th and 8th districts; similarly, the wave of 233 meters will be authorized for use only in the 2nd, 5th and 7th districts, while waves 224, 226, 229, etc., in column two, will be allocated in every district. This plan, it is believed, will tend to prevent considerable local interference, and create virtually an "A-1" class of stations within the general A class.

District radio supervisors, as they are now called, are assigning Class A waves now, but the transfer of B stations from 400 meters will not be made until noon on May 15.

DISTRIBUTION OF BROADCASTERS BY DISTRICTS

In the distribution of 582 broadcasters by districts on April 1, the 9th, the largest including the states of Indiana, Kentucky, Wisconsin, Illinois, Minn., Iowa, Missouri, N. Dak., S. Dak., Neb., Kansas, Colo., and the upper part of Michigan, is seen to be in the lead with 190 stations, followed by the 8th which includes lower part of Mich., Ohio, W. Va., and the largest parts of New York and Pennsylvania.

The distribution of broadcasting stations in the Nine Radio Districts as of April 1, 1923, is as follows:

Districts	1	2	3	4	5	6	7	8	9	
Class A	27	19	37	31	65	63	56	71	183	Total 552
Class B	1	5	4	2	3	4	1	3	7	Total 30
Total	28	24	41	33	68	67	57	74	190	Total 582

Most of the stations designated here as A are now operating on the wave-length of 360 meters, but will be placed in Class C on May 15, if they desire to continue on 360 meters.

CLASS A BROADCASTING WAVE-LENGTHS

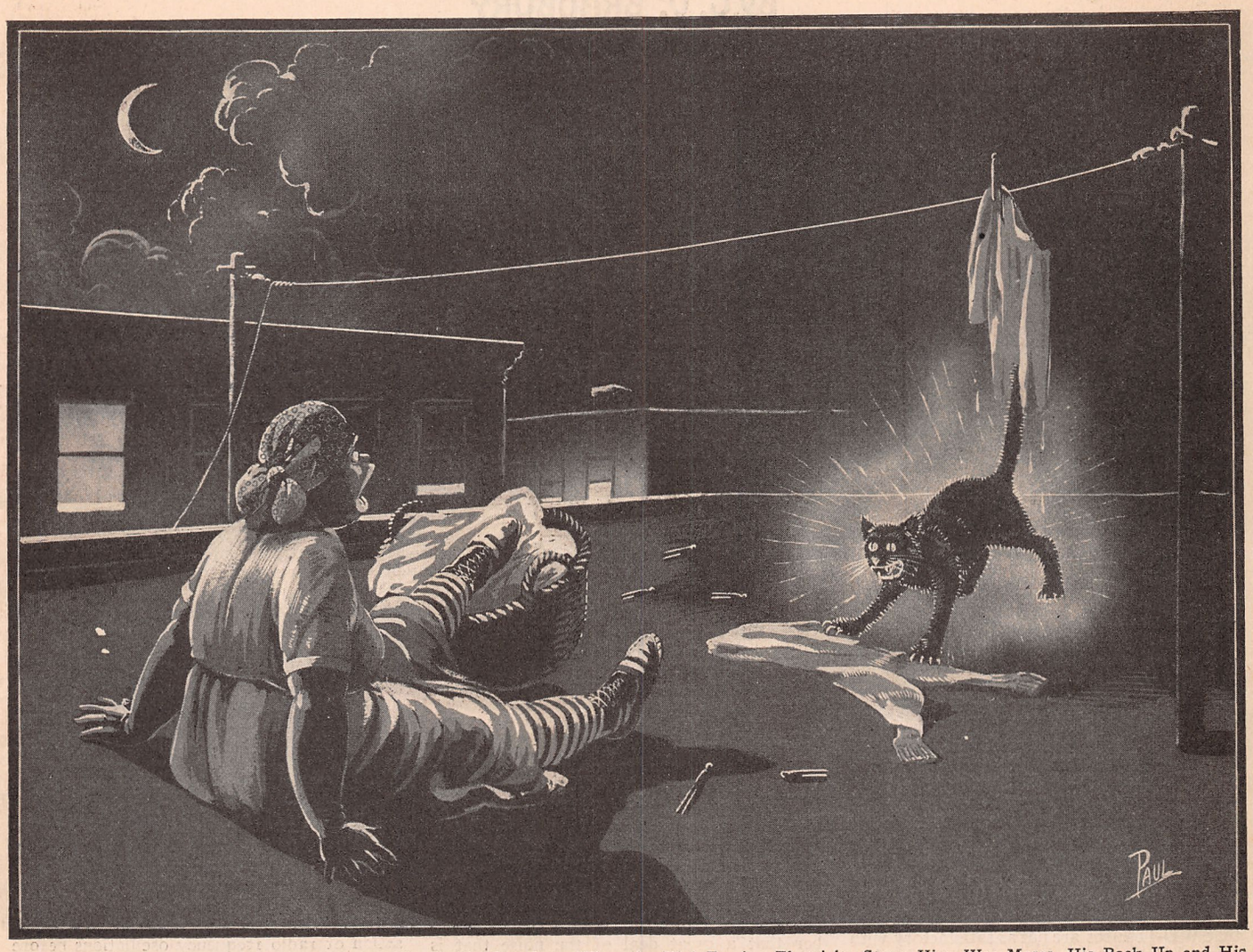
Frequency	All Districts Wave-Lengths	Specific Districts
1350 kc/s	meters—222	(4-5-8)
1340	224	
1330	226	
1320	227	(1-6-9)
1310	229	
1300	231	
1290	233	(2-5-7)
1280	234	
1270	236	
1260	238	(1-3-6)
1250	240	
1240	242	
1230	244	(2-4-9)
1220	246	
1210	248	
1190	252	
1180	254	
1170	256	(1-3-6)
1160	258	
1150	261	
1140	263	(2-5-7)
1130	266	
1120	268	

(Continued on page 64)

Casey's High-Voltage Cat

By ELLIS PARKER BUTLER

Author of "Pigs is Pigs"



And About Ten Feet from Her, Where He Had Landed in One Jump When the High-Tension Electricity Stung Him, Was Moses, His Back Up and His Eyes Fire-Red, and Sparks Spitting from Every Hair. And He Was Spitting, Too. He was Looking Right at Sally.

BEFORE I tell you what I told my landlord about Casey's High-voltage Cat, I want to save you needless waste of time by assuring you that there is absolutely nothing in the idea of substituting a cat for a dry battery in radio work. It is true that if you stroke a cat in a dark room her fur will give off snapping electric sparks, but a cat does not generate enough electricity to take the place of either an "A" battery or a "B" battery. I have tried cats singly, tandem and connected in series; I have experimented with tom cats and tabby cats, olds cats and young kittens, large black cats and extra-large tailless coon cats; I have hooked a wire to the tail of a cat and tried to store her full of electricity, thus making her a cat storage-battery, but it was time wasted. It is cheaper to buy dry batteries. Neither one cat nor forty cats, singly, tandem or in series, will produce enough current to cause any sort of bulb to glow. I admit that I have not tried wildcats, panthers, lions or tigers—because I have never had any handy—but, on general principles, I do not believe the wild cat or the panther, even if producing sufficient voltage, will ever take the place of the dry battery, the wildcat and the panther being inconvenient in the home, especially where there are edible children. If lions and tigers are ever used in place of forty-cent dry batteries it will be, I think, only in zoos or the homes of lion-tamers.

As soon as we moved into this apartment I went to the roof and, as a radio fan should, erected two poles and strung my aerial between them. Almost immediately the janitor came to me and said I must take the aerial down; it was the boss's orders that no aerials should be put on the roof. I immediately put my hand in my pocket and drew out a five dollar bill.

"Here's a queer thing that not many people know," I said, thus cleverly changing the subject; "Every five dollar bill has one of the four first letters of the alphabet on it—A, B, C or D. This bill has a D on it. You never noticed that before? Perhaps your wife never noticed it, either. Perhaps you would like to amaze her by showing her that it is so. Keep that five dollar bill, and show her. We're having nice weather these days, aren't we? I'm glad you called; drop in anytime; good night."

The janitor went away and I hoped that would be the end of it, but a few nights later the landlord himself visited us.

"Them wires you put on the roof——," he said. "The janitor says he told you to take them down, but you didn't do anything about it; you got to take them down."

"Why?" I asked.

"If I let everybody in this building string wires up there," he said, "this place would look like a wire factory. There'd be so many poles up there it would look like a pin-cushion. And them wires draws lightning. If one wire draws one lightning a hundred wires would draw a hundred lightnings, and no building can stand being lightning-hit a hundred times every time there's a storm."

"But, my dear sir!" I exclaimed, "The best authorities say that aerial wires are a protection from lightning!"

I did not know whether the best authorities said this or not, but it seemed a good thing to say. But the landlord did not seem to take much stock in it. He was a heavy, fat man, with a reddish face, and he looked stubborn. I saw that the only thing to do was to get him interested in radio, so that he would love it and wish us to have it in the home, and be eager to have the wires on the roof if we needed them there. I asked him if he knew anything about radio, or about its uplifting and ennobling influence, and he said he did not. So I made him take a cigar and I put on my merriest look.

"Every landlord," I said, "ought to insist that every tenant has a radio outfit. He ought to put in his lease 'The party of

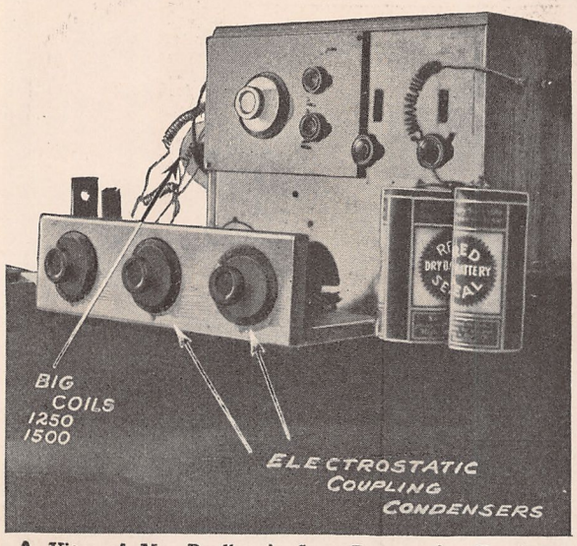
(*Continued on page* 56)

Awards of the Super-Regenerative Contest

Super-Regeneration With WD-11 Tubes

By G. V. BRADBURY

First Honorable Mention



A View of Mr. Bradbury's Super-Regenerative Receiver, Which Employs WD-11 Tubes. The Main Controls Are Situated in the Foreground.

IF beauty is a requisite in this contest, then the set about to be described will be sadly lacking. The circuits are being changed about every day, and it was not deemed worth while to mount the outfit in a cabinet. The author originally constructed a three-circuit variometer and coupler set, and the present super was built about the nucleus, or perhaps I should say remains, of this. On the old set, five-volt tubes were employed, and the filaments were heated by dry cells, as a storage battery is a nuisance in the home. When WD-11 tubes were put on the market, these were promptly installed, and are the only tubes used at present. The author is of the opinion that WD-11 tubes are not as satisfactory with a tuned plate circuit, i. e., variometer in plate circuit, as they are with a feed-back coupling. This may be due to low internal capacity.

Various attempts were made to operate the super with tuned plate circuit regeneration, and none of these were satisfactory, possibly for the reason mentioned in the preceding paragraph. At any rate in the author's opinion, if the advantages of super-regeneration are to be obtained, the mutual inductance between plate and grid inductances must be high, and *inductive coupling must be employed.*

THE CIRCUIT

After the above remarks we may proceed to the circuit employed, which is shown in Fig. 1. From inspection of the circuit it is seen that no loose couplng is employed between antenna and grid circuits. While this reduces selectivity to some extent, it gives somewhat greater efficiency. The variocoupler employed to couple the plate and grid circuits was made by the Atchison Radio Company, and mounted on a hard rubber panel by the author.

It has 45 turns on a 4" stator and about 40 turns on a 3" rotor. The stator is tapped and at present arranged for the fine and coarse adjustment, but when a variable condenser is employed, fine adjustment is not necessary. Also, when using a standard coupler in this circuit, at least 35 turns on the stator must be used, or the mutual inductance between plate and grid circuits will not be high enough. The author believes it would be desirable to wind the rotor with smaller wire, about 60 to 80 turns, but an ordinary coupler *will work.*

As to the method of producing the variation frequency; this is done with a 1500 turn coil in the grid shunted by a .0025 Dubilier "Micadon," and a 1250 turn coil in the plate, shunted by a .001 "Micadon." Electrostatic coupling is secured between the two by two Teleradio 43-plate variable condensers, in parallel. The coils are also arranged so that either full or reverse inductive coupling may be obtained between them. This may be done by drilling a hole in the base of an ordinary coil-mounting and fastening it with a screw so that it can turn on its horizontal axis. Or the coils may be attached to cords and rest directly on the table so that they can be turned over or put in any desired position.

One step of audio frequency amplification is employed. This is not necessary, but for some signals will be found desirable. A Dongan A6 transformer is used, primary shunted by a .001 Micadon.

OPERATION

Now as to operation, the first thing is: "look out for your ears." This circuit is subject to more squawks, squeals, growls, machine-gun bursts, and grunts than any the author has ever operated. At times when interference is bad, or static strong, it is difficult to use it to advantage. This is, however, true of all circuits. Those who construct a set of this kind should remember that a great deal of the noise that is heard is due to the heterodyning of broadcasting stations and receiving sets. On some night when it is very difficult to hear anything but moans and wails, do not blame it on the tubes or batteries, wait until next morning or late at night and try again. You will find an almost entire absence of noise except static, when broadcasting has thinned out.

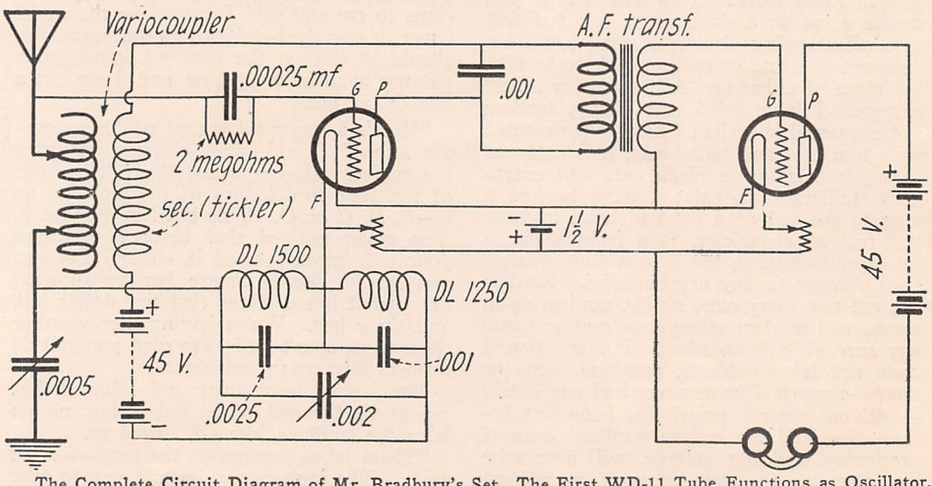
Suppose that you have the apparatus in front of you and are ready to receive. Turn the filaments up to almost a full heat, with the tickler coupling (between plate and grid circuits) at minimum, the coupling between the big coils at minimum and the electrostatic coupling at minimum. Increase the tickler coupling until the tube "spills over" with the characteristic racket. Then increase the electrostatic coupling, or the inductive coupling between the big coils until the "spilling over" stops and the high squeal of the variation frequency is heard. Then tune the grid inductance (coupler stator) and variable condenser until the signals are brought in. Remember to use all the grid inductance possible, which is generally the whole winding, for broadcasting stations. It might be mentioned here that unless a loop or small antenna is used, this set is not good at amateur wave-lengths.

After the above adjustments have been carried out, adjust the electrostatic and inductive coupling between the big coils until best results are obtained. The note of the variation frequency may be objectionable to some people, but it has not been found so to the writer. There is no simple method of getting rid of this shrill note, without destroying signal strength to some extent. However, the squeal may be made less noticeable by putting the DL-1250 in the grid, shunted by a .0025 "Micadon" and the DL-1500 in the plate, without any capacity across it. This will sharpen the tuning and lessen the noise, but will also decrease signal strength.

Very little discussion of the theory can be attempted in this kind of an article. It is an accepted fact, however, that the limit of stable regeneration is reached when the tube begins to oscillate. Now if we employ a super-imposed frequency, which acts roughly as an interrupter, to change the grid potential at the rate of some ten thousand cycles per second, we may cause a cessation of radio frequency oscillations before their amplitude has become large. In this way the regeneration may be carried to a point that cannot be reached in the ordinary regenerative circuit. With apologies to Major Armstrong for some possible inaccuracies in above explanation, this is as far as the author will attempt to cover the theory.

The antenna used was of No. 18 insulated

(*Continued on page* 70)



The Complete Circuit Diagram of Mr. Bradbury's Set. The First WD-11 Tube Functions as Oscillator, Regenerator and Detector; the Second Tube is Employed for Audio Frequency Amplification. The Fixed Condensers Connected Across the Honeycomb Coils Should Be Composed of a Good Grade of Copper Sheeting and a Mica Dielectric. A Common "B" Battery May Be Used for Both Tubes. Although Separate "B" Batteries Are Advisable.

A Super-Regenerative Receiver

By H. L. Hodson

Second Honorable Mention

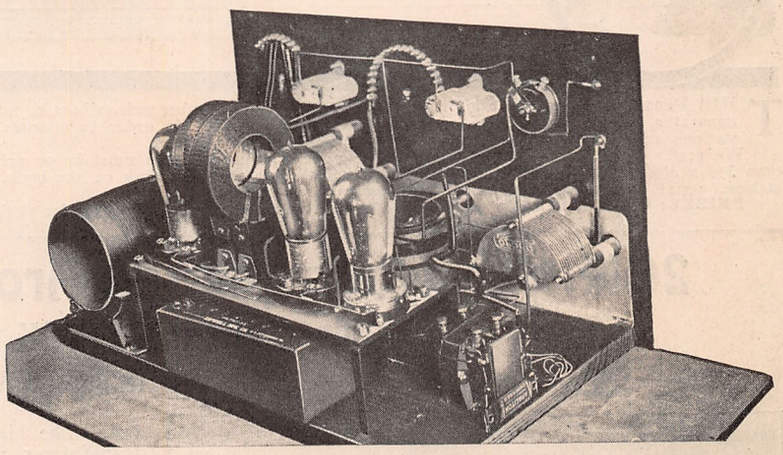
I HEREWITH enclose a diagram of the wiring connections, photographs of the set and detailed data and the written statements of two men who have enjoyed the advantages of a super-regenerative receiver.

I never had any experience with radio until I built my set, so you can readily see that anyone having a little patience can make the required parts and assemble the set and enjoy a real pleasure in being able to have others listen in on the station you want, and hear just that one only.

I first built the two-step set as described by Mr. Paul F. Godley last year in "Radio Broadcast," except that I made the air choke 400 turns and tapped out eight places of 25 turns on one end so as to make it variable, which helps greatly in tuning in, and I also reversed the "A" battery connections; otherwise the wiring and the set are as described by him.

The loop is wound with 7-strand No. 22 twisted wire, 12 turns separated ½" on a 3½' square. I also use an aerial 150' long of No. 14 wire, which is connected to the top binding post of the loop; this increases reception, and enables me to receive in a radius of about 1,000 miles, the distance increased from 150 miles as I learned to handle the set.

I next added one stage of audio, so as to be able to use a loud speaker and it is this set that this writing pertains to, as the 3-tube set is just an enlargement of the 2-tube set.



A Rear View of Mr. Hodson's Receiver. Radiotron UV-202 Tubes Are Used Throughout.

DESCRIPTION OF APPARATUS

Following is a description of parts of the set: One variocoupler of special design, consisting of tubing 4" high and 4" in diameter, with a regenerator inductance coil at the bottom consisting of 35 turns of No. 22 D.C.C. wire; at the top a stator winding of 26 turns of No. 30 D.C.C. on each half, and the rotor which is 3" in diameter and 1½" long is wound with 26 turns of No. 30 D.C.C. wire. All this is mounted on a 4½"x4½"x7⅞" wood block and shellacked. The air choke coil is wound on a tube of 5" diameter and 8" long and supported by blocks cut to fit under each end and shellacked and is wound with No. 28 enameled wire of 400 turns, as described above.

3—Cotoco .001 M.F. variable condensers.

1—.005 fixed condenser.

2—Bradleystat filament controls.

1—Vernier filament control.

1—Dayton audio frequency amplifying transformer.

3—Power tube sockets.

3—Radiotron U.V.-202 tubes.

1—Bakelite panel $\frac{3}{16}$"x12"x21".

2—"C" batteries 0 to 12 volts.

1—"B" battery 100 to 200 volts.

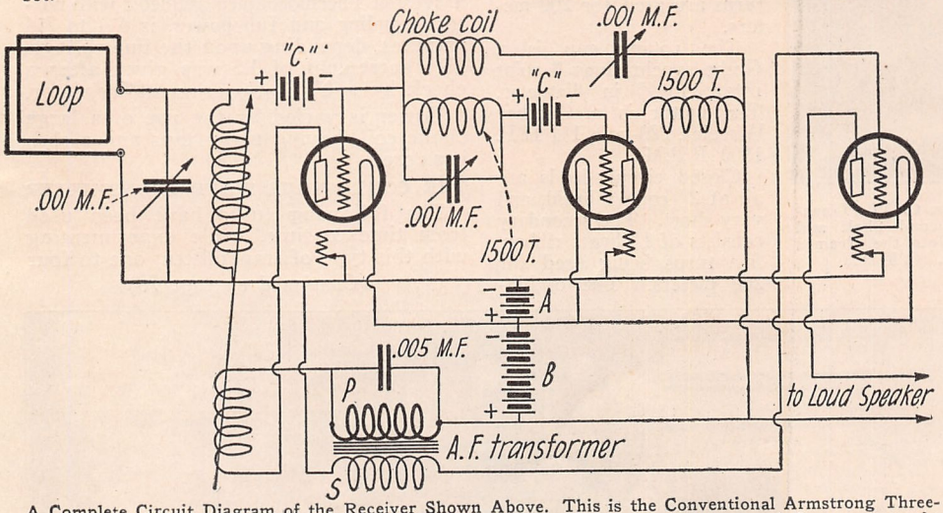
4—3" dials.

2—Contact arms, 1½" radius.

30—Contact points.

6—Terminals for loop and battery connections, all mounted on and to the panel and wood base. (I used a bench mounting for the tubes, sockets and honeycomb coils.)

2—1500-turn honeycomb coils manufactured by the Coto Coil Co. I experienced some trouble when I first built my set, due to bad material which I had to replace, as one tube was broken down between the grid and filament, one fixed condenser shorted and a screw with the threads stripped on a coil support. When I was sure of the wiring and material, I was still unable to tune in, but I kept trying for several evenings and first heard KSD and from then my list grew and is still growing and so does my "company" when I am home. I am now using a Western Electric loud speaker.



A Complete Circuit Diagram of the Receiver Shown Above. This is the Conventional Armstrong Three-Tube Super-Regenerative Hook-up. The First Tube is Employed as the Detector and Regenerator; the Second Tube is the Oscillator, and the Third Tube is Employed for Audio Frequency Amplification.

A Simple Single-Tube Super

By F. Keil

Third Honorable Mention

I AM submitting the following information on my single-tube Super-Regenerative receiver, for the reason that I believe the set is as simple and efficient as it is possible to make the Armstrong super-circuit. The results obtained from it have been more than satisfactory. Unlike the usual super-regenerative set, only one condenser is used across the two large honeycomb coils, and this of a comparatively low capacity. The lower the capacity of this condenser, the higher the variation frequency will be, but, at the same time, a decrease of this capacity will decrease the volume of received signals. There should be a happy medium, though. I find that a variable condenser, with a maximum capacity of .001 M.F. (43 plates), pretty well fills the bill. The tuned plate method of producing regeneration is well adapted to this circuit and, in all-around work, is superior to the tickler feed-back type.

APPARATUS USED

The circuit diagram is shown in Fig. 1. The elements used in this circuit are: L-1 loop aerial, size optional; L-2 Giblin Remler, 1250-turn coil; L-3 Giblin Remler, 1500-turn coil; L-4 Standard moulded variometer; C-1 (11 or 23-plate) variable condenser. C-2 should be a 43-plate condenser, at least, and C-3 fixed phone condenser, of .002 M.F. capacity. For best results the vacuum tube should be a U.V. 201, C-301 or a Signal Corps V.T.-2. With the first two mentioned,

(*Continued on page* 68)

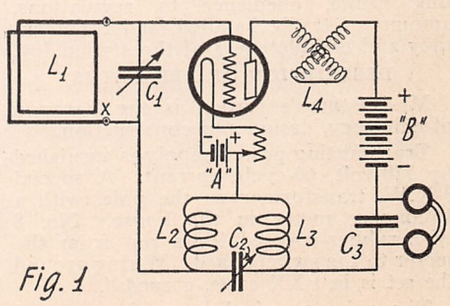


Fig. 1

Here is the Circuit Used by Mr. Keil. A Variometer is Employed for Obtaining Regeneration.

THIS Department is open to all readers. It matters not whether subscribers or not. All photos are judged for best arrangement and efficiency of the apparatus, neatness of connections and general appearance. In order to increase the interest in this department, we prefer to publish photographs of stations accompanied by a picture of the owner.

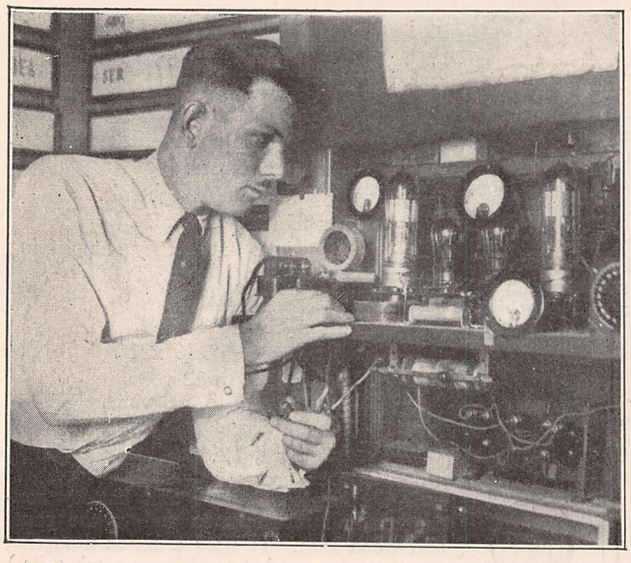
We prefer dark photos to light ones. The prize winning pictures must be on prints not smaller than 5 x 7". We cannot reproduce pictures smaller than 3½ x 3½". All pictures must bear name and address written in ink on the back. A letter of not less than 100 words giving full description of the station, aerial equipment, etc., must accompany the pictures.

PRIZES: One first monthly prize of $5.00. All other pictures will be paid for at the rate of $2.00 each.

2OM, America's Best All-Around Amateur Station

Owned by FREDERICK B. OSTMAN

This Month's Prize Winner



A Photograph of Mr. Ostman, Standing Near His C. W. Transmitter. Note the Two Fifty-Watters on the Second Shelf and the C. W. Transformer Directly Below. Also Note the Frames Containing the "Report Cards." Looks Neat. © *K & H*

THE highest honor in amateur radio, the Hoover cup of the American Radio Relay League, was awarded this year to Station 2OM, operated by Frederick B. Ostman, of Ridgewood, N. J. Announcement of the award was made at the League headquarters in Hartford, Conn., by a committee of three judges selected by Hiram Percy Maxim, President.

The cup, which is awarded annually by the U. S. Department of Commerce, through Secretary Hoover, is given to the best all-around radio station, the major part of the equipment of which is home-made.

Important factors in its selection are ingenuity in design, construction and arrangement, efficiency, consistent transmitting range, obedience to regulations, amount of traffic handled, and the accuracy and completeness of the station log.

DESCRIPTION OF APPARATUS

Mr. Ostman's station is the Paragon of efficiency, design and construction.

Transmitting power-supply is furnished by 110-volt, 60-cycle current. A special 3-K.W. transformer on the pole, with a 15-ampere meter in the house. No. 8 wire rubber-covered leads run from the meter to the switchboard. Wiring around the set is in BXX cable, grounded.

The primary of the transformer and rotary spark gap mains are protected with large 5-K.W. Dubilier kick-back preventors. The high-voltage transformer is a 1-K.W. United Wireless transformer, with a secondary giving 30,000 volts. The condensers in use are two special Dubiliers, of .014 mfd. capacity, in series connection. Parallel to these is a large section of plate-glass condensers, immersed in oil, with an approximate capacity of .009 mfd. The primary of the oscillation transformer is of 3-inch brass ribbon; 1¼ turns are used for 200 meters.

The rotary gap is a Grebe synchronous 8-point rotor, 10½" in diameter. The motor is a Crocker Wheeler, 220-volt, 1¼ H.P. 1800 R.P.M.

Closed circuit leads are all of 2" copper braid, and very short. The secondary consists of 1" brass ribbon, five turns being used for 200 meters. The oscillation transformer is constructed throughout of ½" bakelite supports. The secondary is hinged, to vary the coupling (pancake type). Normal coupling is 6".

The antenna transfer switch is a home-made, angle triple-pole switch, mounted on half-inch bakelite. This breaks the antenna circuit for transmitting and receiving. The separate transmitting grounds and counterpoise run directly from the secondary of the oscillation transformer.

Rotary-gap and power are controlled by the SPST switches, mounted alongside the right side of the operating table.

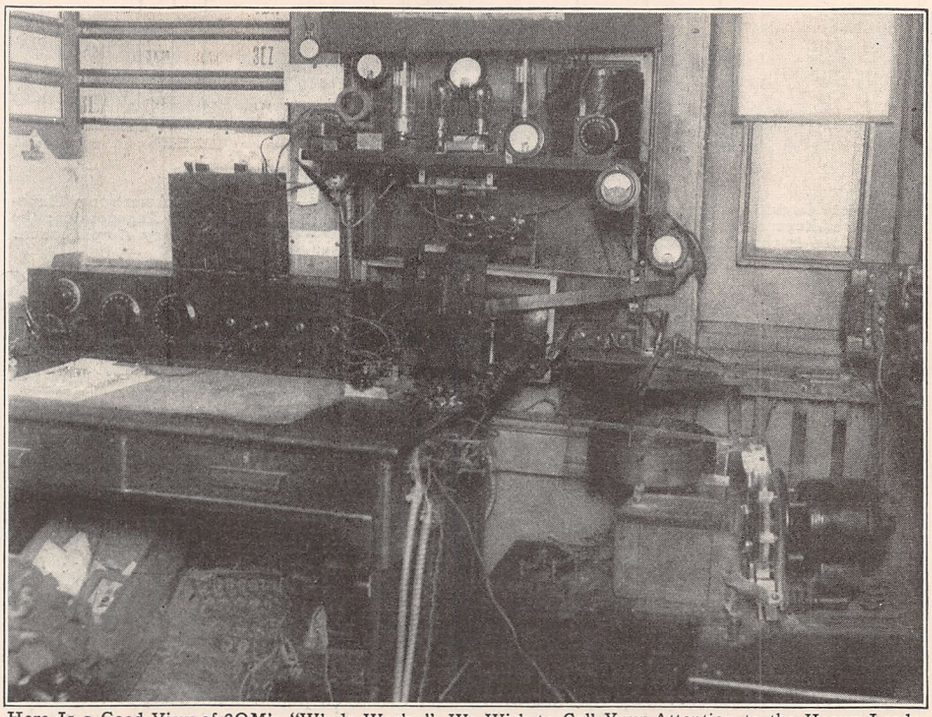
Radiation on the spark transmitter by a Weston Thermocoupled ammeter with normal coupling and full power, is 6½ to 7½ amperes, depending upon the line voltage. The decrement of 1.5 was given after a check by a U. S. Government inspector.

Power is varied by the use of a large choke coil, having many taps and a sliding core.

THE CONTINUOUS WAVE TRANSMITTER

The following tubes have been used from time to time, while experimenting with this type of transmitter; one to four

(*Continued on page* 78)



Here Is a Good View of 2OM's "Whole Works." We Wish to Call Your Attention to the Heavy Leads Used in the Transmitting Circuits. Some of You Bugs Would Have More of a Chance at the Hoover Cup, if You Followed Suit. Although the "Rotary" is Large Enough to Choke a Cow, it Hasn't the Kick of the "Bottles." Mr. Ostman's Receiver is a Bird. It Was Fully Described in the December, 1922, issue of RADIO NEWS. © *K & H*

E. W. Rouse's Station
Galveston, Texas

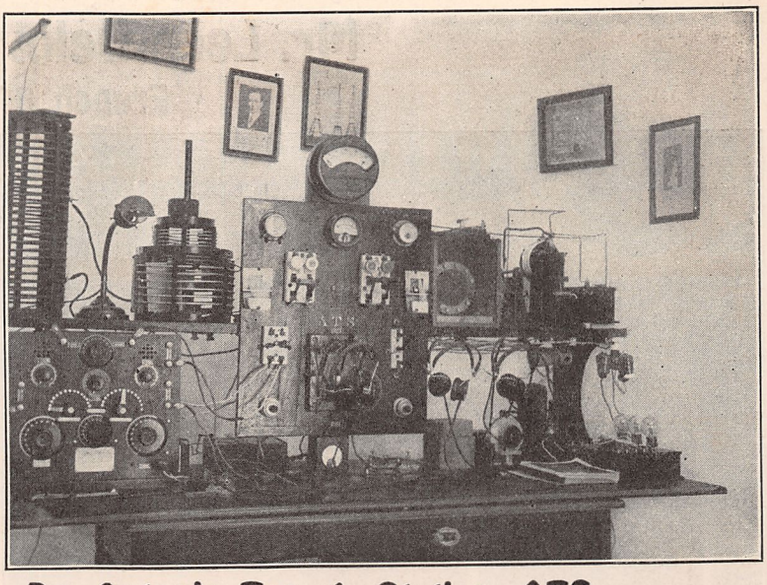
HEREWITH is a photograph and description of station 5IM.

The receiver is of the single circuit type with detector (no amplifier being used at present) and gives excellent results. Contrary to theory it shows a remarkable degree of selectivity, comparing very favorably with the three-circuit sets. It has the advantage of tuning to higher waves without much loss on the lower scales, (200 meters).

The transmitter, in spite of its "junky" appearance has been heard in every district, Canada, Cuba, Mexico and the Panama Canal Zone. Actual work has been done with all districts excepting the second and third. 3BPF furnished the most novel report, advising reception QSA on a Grebe CR-8 without aerial or ground, and using no amplifier.

A 5-watt tube is arranged in a reversed feed-back hook-up. The plate is fed 750 volts alternating current, no attempt being made at rectification. The antenna current fluctuates from .60 to 1.50 amperes in accordance with weather changes. This antenna is a four-wire cage 30′ high and 35′ long with a counterpoise of a single wire 30′ high and 250′ long, being strung at an acute angle to the cage. A rectifier is being constructed and this with the planned 50-watt tube will probably cause the postman to have heart failure.

E. W. Rouse,
"WR" Radio 5IM.



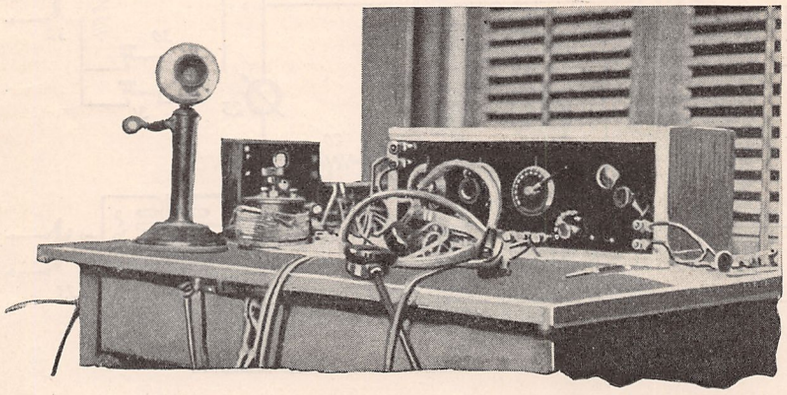
Dr. Toma's Station is the Best We Have Seen from Cuba Way. It Has a Good Record as Well as Appearance. Note the French Amplifying Unit on the Extreme Right of the Table.

Dr. Antonio Toma's Station, ATS

I HAVE the pleasure of submitting a photograph of my radio station ATS, at Cienfuegos, Cuba. The station is equipped with a ½-KW. spark transmitter, having both quenched and rotary gaps. The transformer is supplied from a 220-volt, 60-cycle electrical plant. An oscillation transformer is used to couple the oscillatory circuit to the antenna system. The large panel in the center of the photo has the controlling switches for the transmitter, as well as the antenna switch. The radiation meter is mounted at the top of this panel.

My receiving set is home-made, being of the regenerative type employing the popular two variometer, variocoupler circuit. A two-stage audio frequency amplifier is included in the same cabinet. Numerous American stations have been heard; the record distance is 1,900 miles.

My antenna is of the cage type, having six wires supported by bicycle rims. This aerial is 60′ high and 75′ long. Considering the amount of static in these parts, both receiver and transmitter have performed well.



Although 5IM May Not Have Frills and What-Nots, He Gets Real Service from His Station. The Transmitter is a Five Watter. No Amplifiers Are Employed with the Receiver.

9DQW

The call letters 9DQW have been assigned to Minard T. MacCarthy, 701 Eastgate Avenue, St. Louis, Mo., instead of the Maplewood High School Radio Club.

8DIP

The call 8DIP has been issued to Stanley M. George, of Reesville, Ohio. Appreciate QSL's.

7FT

The call 7FT has been reissued to Arthur Rosere, 1718 N. 14th Street, Boise, Idaho. Would appreciate word from persons logging me.

4 QM

The call 4QM has been issued to J. L. Cooper of 2017 W. Charlton Street, Savannah, Ga.

Calls Heard

B. AITCHISON, 202 W. CLIFTON TERRACE, WASHINGTON, D. C.

1GS, 1KV, 1AHZ, 1AZL, 1BOP, 1CAB, 1COT, 1AP, 1BES, 1BUR, 1JV, 1CPI, 1ZE, 1ATJ, 1ANQ, 1ATV, 1ACA, 1AOF, 1BCM, 1BAS, 1BOM, 1BEC, 1BVC, 1BVS, 1CMP, 1CAK, 1CKA, 1II, 1MC, 1XM, 1WC, 1BVS, 1BMP, 1OW, 1QO, 1APC, 1FS, 1IL, 1FB, 1AKL (QRA?), 2AGB, 2AUY, 2BGI, 2BVH, 2CRA, 2CKL, 2CXN, 2SQ (QRA?), 2GK, 2CCD, 2CQZ, 2FP, 3's too numerous, 4EB, 4FA, 4JK, 4KL, 4NT, 4NV, 4OI, 4IK, 4FT, 4YA, 4BI, 4CM, 4CQ, 4EA, 4HS, 4KK, 4NA, 4PL (QRA?), 4GL, 5DQ, 5ABH, 5AAF, 5SP, 5KC, 5NS, 5ADQ, 5ADO, 5AA, 5EK, 5IX, 5JS, 5KN, 5MO, 5MB, 5NC, 5PV, 5CG, 5AZ, 5SM, 5SP, 5ZA, 5ZG, 5BU, 5UK, 5XB, 5KP, 5EL, 5ADB, 5XV, 5PN, 5PF, 5JW, 6KA, 6CC, 6XAD, 6ZZ, 6ANH, 6NX, 6JX, 6ZY, 7ABB, 7ZU, 7DC, 7WM, 7ZO, 7AN, 7BH, 7ACH, 8AFY, 8AJ, 8EJ, 8VWT, 8UF, 8LT, 8AVL, 8BHY, 8DAG, 8MC, 8AJX, 8KJ, 8BWT, 8BUT, 8FU, 8ASV, 8ABS, 8AIA, 8AOL, 8HH, 8NB, 8AUX, 8BMF, 8BVE, 8BFO, 8CID, 8CF, 8DAK, 8DWP, 8HN, 8ABS, 8BFO, 8HN, 8AOL, 8ARB, 8BO, 8BPE, 8BYU, 8CGI, 8CUR, 8EV, 8NB, 8SM, 8XP, 9CDU, 9IO, 9IF, 9CCS, 9AAU, 9DQM, 9DES, 9BCF, 9AZA, 9ADF, 9BKK, 9APW, 9EP, 9CEI, 9DUQ, 9CJC, 9CFN, 9DGE, 9PF, 9RC, 9UU, 9ZT, 9XM, 9IL, 9AMT, 9ATO, 9CND, 9ARI, 9DEX, 9CVE, 9AOG, 9PQ, 9DKY, 9XJ.

Spark: 4HS, 1BOQ, 4IK, 8CF, 8CFV, 8FU, 8ASV, 8CF, 8BFO, 9BDH.

Canada: 2AP, 3JL, 3OH, 3ME, 4HH, 9AJ, 9BU.

Dalite: CW: 1KV, 2BGI, 2BVH, 2CCD, 2FP, 3's too numerous, 4FA, 4JK, 4NT, 4PL, 5PF, 5UK, 5MO, 5ZA, 6ZZ, 8AJX, 8KJ, 8ABS, 8FU, 8QK, 8MO, 9FP, 9AOG, 9UU.

Using 3-foot loop: 1BOQ, 1BES, 2FP, 2BGI, 3APT, 3YO, 4NT, 5XK, 8MC, 8UF, 9AZA.

WILLARD CONSTANTINIDES, RUTHERFORD, N. J. (1 STAGE A.F.)

1ABY, 1ACB, 1AGH, 1ALI, 1ANQ, 1ARY, 1ASI, 1AWB, 1AY, 1BGD, 1BVR, 1BXH, 1CKQ, 1CMP, 1CNP, 1CRW, 1GV, 1YT, 1XX, 2CBC. 3AIC, 3BLP, 3BTL, 3BVH, 3CEO, 3MB, 3TR, 3VR, 3YV, 4AG, 4DO, 4EA, 4FA, 4FC, 4FS, 4FT, 4GW, 4GZ, 4IR, 4IV, 4JK, 4JL, 4KM, 4MW, 4NV, 5ABY, 5AGJ, 5DA, 5DM, 5DQ, 5IX, 5KC, 5MO, 5QI, 5VK, 5XK, 5KW, 5ZA. 38 heard in 8th district. 9BZI, 9CCV, 9CMJ, 9CPB, 9DCG, 9DKY, 9DRI, 9DSD, and 17 others.

Spark—3YK.

Canadian—3ABN, 3IV.

H. RALPH HOWLETT, TORONTO, CAN. (PEANUT TUBE AND LOOP)

Canadian C.W. and Spark—2HJ, 3AL, 3AT, 3BP, 3CE, 3CO, 3DE, 3FZ, 3GE, 3GK, 3HH, 3IH, 3IL, 3IN, 3IR, 3IS, 3JG, 3JL, 3JO, 3JT, 3LY, 3OE, 3OH, 3PG, 3SI, 3SK, 3SV, 3SX, 3TD, 3TF, 3UK, 3UQ, 3WD, 3ZK, 3ZL, 3ZR, 3ZS, 9AJ, 9BH, 9BV.

Phones—3AAO, 3AB, 3ABZ, 3AP, 3AQ, 3CF, 3CJ, 3EL, 3FC, 3FD, 3FF, 3FL, 3FO, 3KB, 3II, 3OA, 3OJ, 3PD, 3PF, 3PJ, 3PP, 3PR, 3PT, 3TR, 9AW, 9BJ, 9BV, 9CV.

American C.W. and Spark—1BTR, 1YD, 2AGB, 2CKL, 3ADM, 3AHP, 3AJO, 3ANG, 3BHM, 3BJ, 3BMN, 3HL, 3HS, 3MB, 3NS, 4AQ, 5BK, 5DA, 5EB, 5KC, 5NV, 8ABN, 3AFL, 8ARB, 8ATL, 8ATP, 8AZC, 8BDU, 8BF, 8BHO, 8BNU, 8BNZ, 8BRL, 8BRT, 8BUT, 8CEI, 8CHF, 8CKO, 8CLZ, 8CPD, 8CRB, 8CRC, 8CUR, 8CVX, 8DAG, 8DF, 8ER, 8KU, 8QK, 8UE, 8UF, 8ZW, 9AMO, 9BCH, 9BKJ, 9BOO, 9CCS, 9CD, 9CNH, 9CVO, 9EP, 9KQ, 9MN, 9RC, 9UU, 9VD, 9VU.

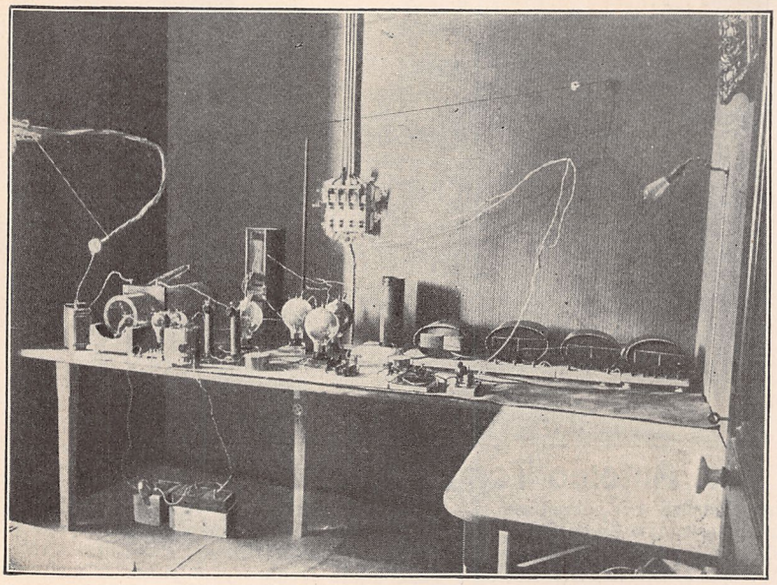
1CNA, HUDSON, MASS. (1 STAGE A. F.)

1ST, 1XX, 1BKQ, 1ARY, 1CDR, 1LL, 1AOK, 1BWJ, 1BAS, 1BRQ, 1BET, 1BVH, 1BYN, 1JV, 1GV, 1ADN, 1CNF, 1CSW, 1ALG, 1AIH, 1AIL, 1AIW, 1CKB, 1AAC, 1BAN, 1BQI, 1YA, 1BHR, 1KW, 1BOQ, 1YK, 1BOA, 1AWZ, 1CJA, 1EO, 1AYZ, 1GS, 1XU, 1RL, 1CN, 1PF, 2HO, 2AYV, 2AZY, 2XQ, 2XL, 2CKL, 2CCD, 2BGI, 2CBT, 2CCT, 2CBW, 2OM, 2CBG, 2AWL, 2CMS, 2IX, 2HU, 2CRO, 2BVD, 2AYD, 2CEI, 2CRW, 2LE, 2BZV, 3ZO, 3HU, 3XM, 3BUY, 3BSS, 3BHO, 3TR, 3AWA, 3HH, 3AFB, 3FS, 3NF, 3BLF, 3ANO, 3CDG, 3HD, 3BGT, 3ADQ, 3AHB, 3ZZ, 3ZC, 3AJJ, 3AAE, 3JJ, 3BEI, 3AGA, 3ALN,

(*Continued on page* 83)

Mr. Leon Deloy's Station

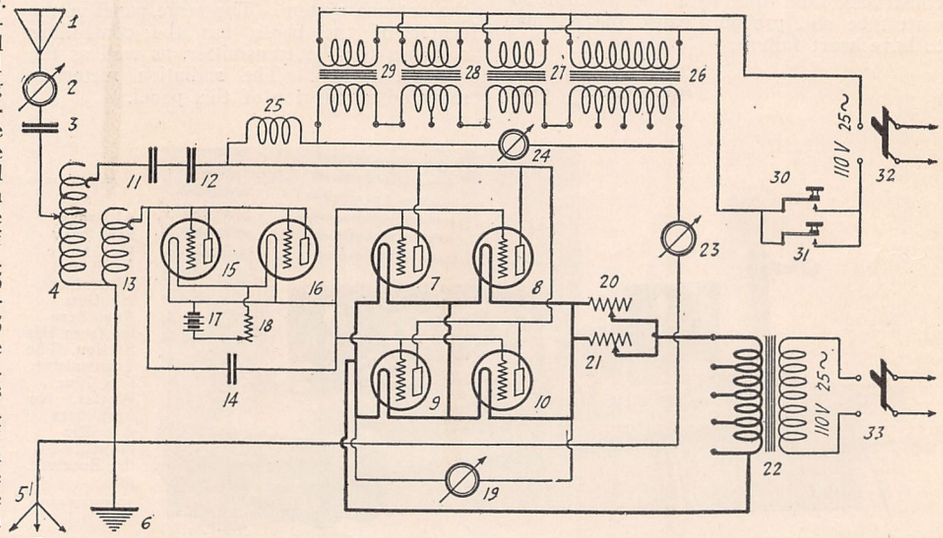
French 8AB



The Interior of Station 8AB. This Shows Only the C.W. Transmitter. The Four 250-Watt French Tubes Can Be Seen in the Center of the Table. The Transformers Are on the Right.

MR. Deloy's station is the only French one heard in this country. During the trans-Atlantic tests it was copied for a long period with its code word ALUDO.

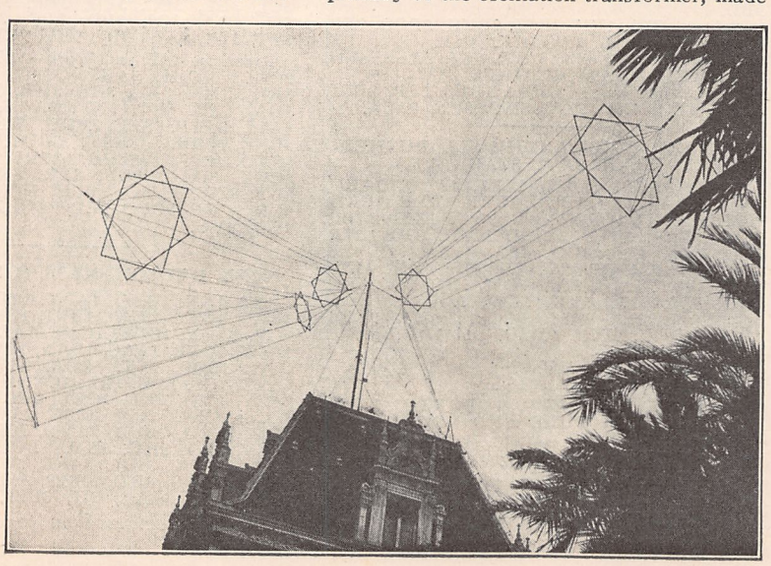
Fig. 1 shows the hook-up of the transmitter with each instrument numbered and having the following characteristics: No. 1 is the aerial formed of three cages, 60′ long and composed of eight wires each; the lead-in is also a small cage 60′ long. The three cages composing the antenna are in the shape of prisms, 12′ in diameter at the free end and 6′ near the lead-in; these are shown in the photograph Fig. 2. Each wire in the aerial is composed of a small cable made of eight strands of No. 26 enameled wire. No. 2 is the hot wire meter, reading up to 5 amperes and No. 3 is the series condenser bringing down the wave-length to 195 meters. With the inductance in circuit, the wave-length jumps up to about 250 meters. This condenser is home-made and consists of photographic plates and copperfoil. No. 4 indicates the C. W. inductance made of 29 turns of copper tubing, about ¼″ in diameter. In the diagram No. 5 is the counterpoise, which was tried during the test, but was found more efficient when grounded, this giving 1/10 amp. more radiation in the antenna. The ground system, No. 6, consists of gas and water pipes and hot water heating system, as well as the lightning rod ground and other metallic surfaces in the neighborhood. The four transmitting tubes, Nos. 7 to 10, are of the 250-watt type. Nos. 11 and 12 are series condensers for the purpose of stopping the high tension from the oscillating circuit.



The Transmitting Circuit Used by Mr. Deloy. The Two 50-Watt Tubes (15 and 16) Function as Grid Leaks. Both Plates and Filaments Are Supplied from the A.C. Current Mains Through Step-Up and Step-Down Transformers.

These condensers are also home-made, as was the one described above. No. 13 is the primary of the oscillation transformer, made of 20 turns of No. 8 wire. The grid condenser No. 14 is also home-made, but smaller. The grid leak is composed of two 50-watt tubes shown at Nos. 15 and 16 in the diagram. The filament of these tubes is heated with an 8-volt storage battery, No. 17, and regulated by means of a rheostat, No. 18. No. 19 is a voltmeter across the filament and Nos. 20 and 21 are three-ohm rheostats in parallel, carrying the 15 amperes necessary to heat the filaments of the transmitting tubes. The transformer, No. 22, steps down the voltage of the 110-volt, 25-cycle line for the filament supply; No. 23 is a milliammeter ranging up to 500 milliamperes; No. 24 is an apperiodic electrometer with maximum reading for 5,000 volts; No. 25 is a radio frequency choke; No. 26, No. 27, No. 28 and No. 29 are the step-up transformers for the plate supply.

The reason so many transformers are used is that 8AB was formerly a small station and during its first months of existence, a tension of 250 volts seemed a whole lot, but in these days of trans-Atlantic work a power of one kilowatt is used with 5,000 volts on the plates. It was necessary to use two keys in parallel—these are shown at 30 and 31 in the diagram—as the only type available was small and could not carry the intensity without heating very much. For this reason, two keys were used to allow the hot one to cool while the second was in operation. The impossibility of securing, in time, several pieces of apparatus prevented Mr. Deloy from making the installations he desired for the trans-Atlantic tests. The home-made condensers, particularly, caused some trouble, as they were warm and formed corona discharges sometimes. Several other improvements, which would have been highly desirable, could not be made on account of lack of time and apparatus which are not manufactured in France and take a long time to come from abroad.



8AB's Antenna System is as Elaborate As Some of Those Employed by American Amateurs. It Consists of Three 8-Wire Cage Aerials 60′ Long and a Cage Lead-in of the Same Length.

AMATEURS PROBE QRM COMPLAINT AND FIND TROUBLE

At a recent meeting of the Executive Radio Council a Mr. Cook made a complaint against a licensed amateur, 2CLW, to the effect that 2CLW was interfering with the reception of broadcasting.

The amateur was turned over to the Radio Club of Brooklyn for investigation and the following is the report of the committee:

"Our QRM investigation committee, up-

(*Continued on page* 105)

A Real DX Receiver

By JOHN H. DIXON, R. E.

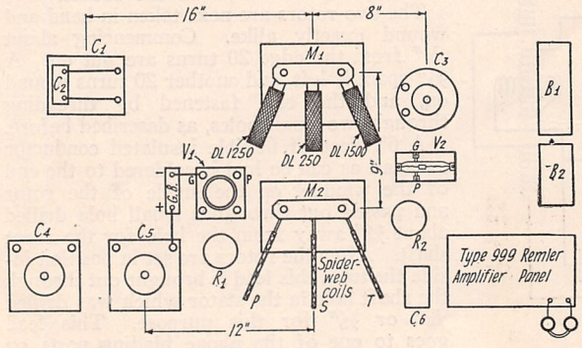
Plant Engineer at Station VMG, Apia, Samoa

WITH the receiver to be described using only two valves I am getting concerts every evening from America, 5,000 miles away, and from Hawaii 2,240 miles away and this means good speech and music. Our time is three and a half hours behind America's which means that part of this concert is received in daylight here. The same concerts can be received on one valve when static sleeps, but not so that they may be enjoyed, and only after much patient tuning. My amateur station is situated about 1,000 yards from the large radio station VMG at which station I am employed as engineer. My aerial is a single 7-strand 80′ long, 60′ high, suspended between two convenient trees. The concerts were received about six months ago, the circuit used then being the Reinartz to which were added three stages of Radio and one stage of Audio frequency amplification.

SUPER-REGENERATIVE RECEIVER USED

The results with this receiver were quite good, but tuning was difficult and it was replaced later by the present adaptation of the Armstrong Super-regenerative. All the articles I have seen on this circuit seem to differ in some respects and mine will be no exception to this. All the nine articles I have filed seem to agree, however, that—Power valves must be used, a C.W. whistle must be tolerated, Coils D.L. 1250 and 1500 must not be in inductive relation, high plate voltage is necessary, and a filter circuit must be employed if audio frequency amplification is to be used.

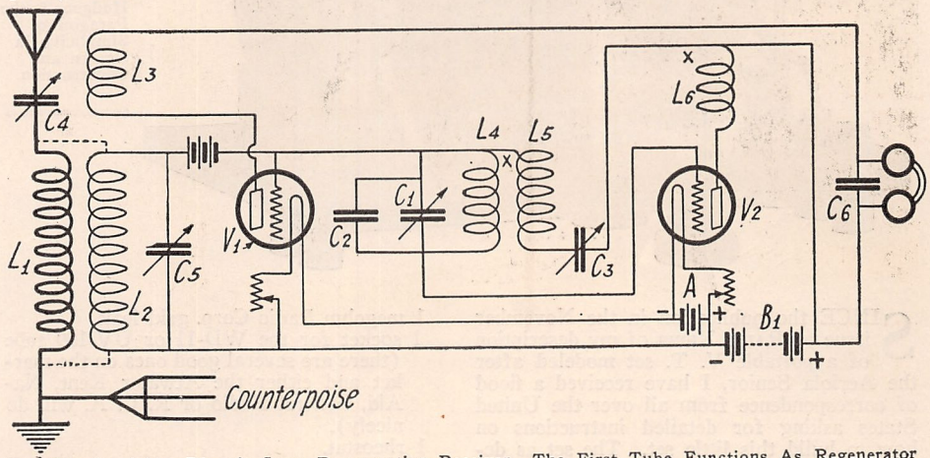
Cancel all the above for the circuit to be described. To date I have heard KHJ, KFI, KUY, KUO, KLP, KWH, KPO, KGU, KDYX, and KDAF. The last named station was heard for the first time on Feb. 22, playing "The Floral Dance." Static was coming in fine and interfered only as the call letters were coming to me, but I think I got them all right. The best of these stations are KPO, KHJ, and KFI. I have pages of log on American Stations. I have already given proof to the Editor of good reception of the Xmas and New Year concerts from KHJ in a former letter.



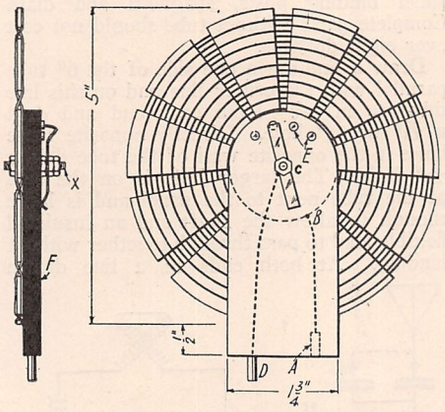
The Layout of the Apparatus Used in the Super-Regenerative Receiver Described in This Article. The Disposition of the Instruments is an Important Factor and Should Be Followed Where Possible.

To prove that the receiver was O. K. I tried it out on the single wire aerial of the American Consul here, and we heard two of the American stations besides those in Hawaii. He is situated at sea level, while my station is about 500′ above this. On the other hand I suffer badly from screening, my residence being in a very small clearing surrounded by trees and plantations.

Most of the material needed for the construction of a similar set will be in the possession of the advanced amateur; the beginner should not attempt to make it. For valves I use a C-301 and a Marconi V-24. A Western Electric VT-1 or a C-302 valve used on six volts without a filament resistance, will do in place of the C-301, but of the valves I've tried, the V-24 gives the best results as valve No. 2. These are splendid about the station, especially for radio frequency work.



The Circuit of Mr. Dixon's Super-Regenerative Receiver. The First Tube Functions As Regenerator and Detector, and the Second Tube as the Oscillator. Excellent Results Are Claimed from This Hook-Up.



Details of the Tapped Spider-Web Coils.

Here I must state that, although a third valve is used, most of the above results are obtained with only two valves and Baldwin type C headphones. When the third valve is used, the same phones are placed on a large tin horn, this giving good music all over a small room. L1, 2, and 3 are the only parts that will need explaining; Fig. 2 gives all the necessary details. The former is made of $\frac{1}{16}$" red fibre. No. 28 D. S. C. wire is used for the primary and secondary and No. 30 D. S. C. for the tickler. The coils are mounted in a standard three coil mounting as are the D. L. coils L4, 5, and 6. It will be noticed that the primary and tickler coils have one vane of the former made longer than the rest. This is used as a handle to vary the position of the coils. Take care that all the windings run in the same direction when fastening to the mountings. It is also a good plan to connect all the commencing ends of the wire on the three forms to similar terminals of the plugs. As will be seen, I use tapped coils, but it would be better to make up a set of coils for the different wave-lengths required without taps. The fixed condensers should be of the best make and should have mica dielectric. Ordinary cheap receiving condensers will not do, and will only cause a loud C. W. whistle if used as C2. Those of you who can get hold of a Megger should test the insulation of C2 and discard it if it does not give an infinity reading. C2 of course may be made up of two or three smaller condensers in parallel. This circuit will be found to differ from the usual at the places marked X in the circuit diagram. It will also be noticed that only one grid battery is used, this in my case being of 13 volts. B1 should be at least 100 volts, and should be placed on photographic plates or some such insulation. Incidently this insulation of the several units of the set is very important. Everything from the 6-volt battery up should stand on insulating material—I find glass excellent. Attention to this and to the wiring will cut out noises and make the set more stable once it is adjusted. If rubber shoes are worn, there will be no need to shield anything. The battery G.B. must be very well insulated from the table, and its leads made as short as possible. If three-cell torch light batteries are used, individual cells being connected with short lengths of wire and then replaced in their tubes and again connected together so that the positive terminal is at one end and the negative at the other, the positive may be connected with a short wire to C5 and the negative to the grid of V1 (See Diagram). In wiring up, I use ordinary 18-gauge rubber and braid covered house-lighting wire. It makes an ugly job, but can't be beaten. Cotton covered wire is useless. Take care that the bottom terminal of the secondary goes to the positive, together with the negative of the battery B1. By adding one stage of audio frequency amplification louder signals will be obtained and incidentally louder static. I find a three to one transformer by far the best and am using a Saco Clad. The Remler 333 amplifier panel appeals to me because of its useful transfer switch, but needless to say other types may be used. A separate battery of 45 volts up will be necessary, the negative terminal of this being connected to the negative of the 6-volt battery.

LAYOUT SHOWN MOST EFFICIENT

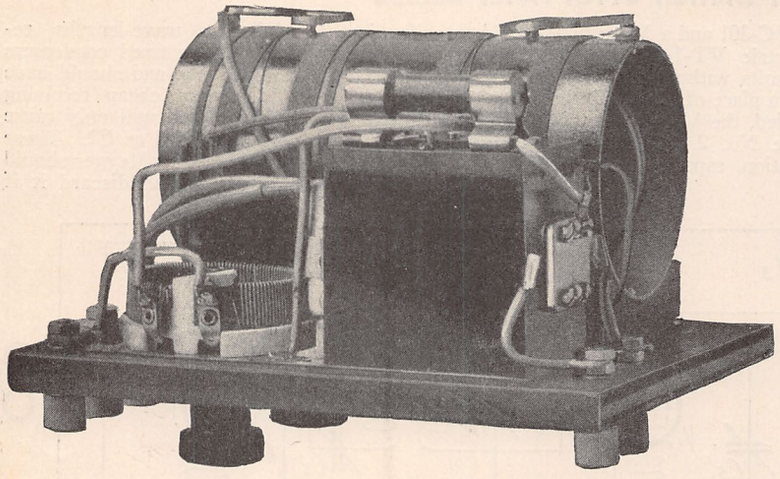
I would advise sticking to the lay-out shown in Fig. 2, the lettering of which is the same as Fig. 1.

Now for the initial adjustment of the set: Place the D.L. coil 250 in the center socket

(*Continued on page* 113)

A Portable Set for the Vacationist

By W. B. HODGSON



The Portable Receiving Set Built by Mr. Hodgson is the Paragon of Simplicity in Design and Construction.

SINCE the publication in the November issue of RADIO NEWS of my description of a portable V. T. set modeled after the Aeriola Senior, I have received a flood of correspondence from all over the United States asking for detailed instructions on how to build this little set. The set as described in that article was designed especially to be entered in the pocket Radiophone contest, and therefore certain changes were necessary in the mechanical shape and the arrangements of the various elements in order to make it conform to the rules of the contest. The great majority of the inquiries which I have received were for data on a set of average size rather than a miniature outfit. I will, therefore, confine myself strictly to the constructional details of the Aeriola Senior, as it is built by the manufacturer.

SPECIAL FEED-BACK SYSTEM

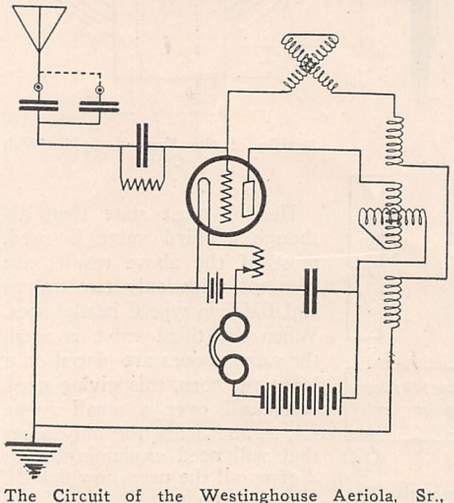
The circuit has one or two peculiarities which I am sure account for the remarkable records this set has made in long distance reception. The method of securing regeneration by means of both a tuned and tickler plate circuit is employed in only two sets on the market today, one the Aeriola, Sr., the other the Colin B. Kennedy apparatus. This feature gives the strong oscillation produced by means of tickler feed back together with the very gradual control of regeneration and oscillation common to any variometer tuned plate circuit. Another unique feature is the fixed antenna circuit condenser. As we all know, the usual single circuit receiver employs a fixed inductance or one variable in steps in series with a variable capacity to resonate the antenna circuit. It is every bit as efficient to have a fixed capacity and a continuously variable inductance, and this is the method employed.

Let us now proceed with the actual constructional details. As this set is operated with the controls in a horizontal position, as the British build their sets, and the great majority here prefer a vertical panel, a few changes will be made in order to adapt the instruments to panel mounting. The parts needed are as follows:

1 piece of bakelite tubing 3¼" in diameter by 6" long with a wall 1/16" to 1/32" in thickness.
2 pieces of bakelite tubing 2¾" diameter by 1⅝" long.
¼ lb. of No. 24 D.C.C. magnet wire.
3 type 601 micadons having the following capacity: .0001, .00025, and .002 microfarads respectively.
1 type 600 Dubilier condenser, capacity .00025 MF.
1 megohm Radio Corp. grid leak.
1 socket for the WD-11 or UV-199 tube (there are several good ones on the market and either the Atwater Kent, Na-Ald, General Radio or R. C. A. will do nicely).
1 rheostat.
A vernier is hardly necessary and is not recommended, as this tube is not critical.

This completes all parts necessary except panel binding posts, spaghetti and dials. Complete parts without tube should not cost over eight dollars.

Draw a line down one side of the 6" tube parallel with the center line and on this line measure in 1 1/16" from each end and drill a 5/16" or ⅜" hole. Directly opposite these holes in the opposite wall of the tube drill a 3/16" hole. The larger hole is on the side of the tube next to the panel and is large enough to allow the shaft and an insulated flexible lead to pass through together without binding. At both ends of a line drawn through the centers of the 3/16" holes drill a small hole, the proper size for a small machine screw. Put these two screws through the holes from the inside and hold them in place with a nut. We are now ready to start winding.



The Circuit of the Westinghouse Aeriola, Sr., Which is Employed in the Above Receiver Because of Its Operating Efficiency. All of the Stationary Coils Are Wound on the Same Form.

Hold the tube horizontally in the hands and fasten the end of the No. 24 wire under the screw at the left hand end and wind so that the winding progresses toward the right. Furthermore, the direction of rotation of the winding should be such that the spool of wire is passed away from you as the wire passes under the tube and comes toward you as the wire is brought over the top. This small detail is important in order that the inductance of the tickler winding may assist and not oppose the plate variometer. When the wire is fastened under the screw head it is brought straight in for about ½" before the winding is started. Just 16 turns are put on and then a space of ¾" is left and the winding again continued for another 16 turns. The width of these two windings is about ⅜" each and they constitute the stator of the tuning variometer. The wire may be stiffened and held securely in place as it is wound, by painting it with liquid bakelite. If this cannot be obtained water glass will do, but is not quite as efficient. The winding is now continued after a space of 1⅜" is left and six turns wound on. At the end of these six turns a very small hole is drilled in the tube and after about 6' of wire is unreeled from the spool it is broken and the end passed down through the hole and pulled through until all slack is taken up. Just 2" further along on the tube and about ⅝" from the right hand end of the tube, a similar hole is drilled and the wire passed back through the tube and six more turns put on.

THE WINDING

Two small holes about ¼" apart are drilled close up at the end of this winding and the wire threaded through once or twice to keep it from unwinding. A lead about 6" long should be left and this is later soldered to the shield behind the panel. In the 2" empty space between the two coils of six turns each is wound the stator of the plate variometer exactly similar in every respect to the stator of the antenna circuit variometer. Be careful to keep to the same direction of rotation as before. The start of this winding is made at the back of the tube so that connection may be made to the rotor by means of a pigtail to the end of the metal shaft of the rotor. The other end of the stator winding is fastened in place with a piece of oiled cambric covered with the varnish and held under the windings. A 6" lead is left at this end, a piece of spaghetti is slipped over this and connection is later made to the plate connection on the socket.

The two rotors are next taken in hand and wound exactly alike. Commencing about 1/16" from the edge 20 turns are put on. A ¾" space is left, and another 20 turns wound on, and the end fastened by threading through two small holes, as described before.

A 6" piece of flexible insulated conductor as small as can be had is soldered to the end of the winding on the inside of the rotor and passed out through a small hole drilled about ¼" away from the hole for the front shaft. After the rotors are set in position inside the tube, this lead is brought out through the shaft hole in the stator which was drilled 3/16" or ⅜" for this purpose. This lead goes to one of the phone binding posts on the panel after the parts are all assembled. This, of course, applies only to the rotor of the plate variometer. The lead from the other rotor is brought out to one side of the antenna series condenser. The other ends of the rotor windings are soldered to the rear shafts which are made of 3/16 brass rod fastened securely into the rotors by means of small brackets on the inside. After the rotors are slipped into place a pigtail is soldered onto the end of these shafts and fastened under the screw heads which were placed in the large tube at the start. There should now be a total of four leads coming from the assembled unit as follows:

1. A flexible lead coming through the front

(Continued on page 97)

Correspondence from Readers

MORE DX

Editor, RADIO NEWS:

On Christmas Day and New Year's Day I had the pleasure of listening to several American broadcasting stations, chief of which were KHJ and KUY. Unfortunately it is still daylight when the stations finish their usual runs, as our time is about three hours behind that of California. I have, however, heard KUY just before our sunset.

On Christmas Eve KHJ played "Song of Love," "Ave Maria," and other selections at 3 o'clock in the morning. At 12 p. m. the announcer wished the following greetings: "A Merry Christmas, that is the wish from KHJ, Los Angeles, California. Hello, Carolina, I hope you get it." These are the exact words. Someone also gave a speech which came in here with wonderful clarity, the following being two extracts jotted down at the time: "How the money has piled up, how the assistance has been given." "And this fund that we have accumulated now known as the Times fund." Not being able to write shorthand I could not do better than the above in the way of speech.

On New Year's Eve KHJ spelled out the words after saying "A Happy New Year," then played a saxophone solo as the first of the New Year. Another piece introduced with "Hello Hawaii" was "Aloha Oe." A siren with rising and falling note was also heard. On the latter occasion static was very bad.

These results were obtained with a two-valve adaptation of the Armstrong Circuit using a Cun. C. 301 and V. 24 valve, this circuit giving the same results as a five-valve set I have, but without the fine tuning qualities. My aerial is single wire 75′ long 60′ high, and is used together with a four-wire counterpoise. I am only 1,000 yards from the radio station VMG, and therefore cannot receive when he is sending.

With either of the above mentioned circuits I can receive concerts from KDYX or KGU, Hawaii, any evening I wish to. A Magnovox added makes the concerts of the same strength as Gramophone music. The above stations are 2,240 sea miles away.

KHJ came in twice as strong as KGU, and the tuning was very broad indeed.

JOHN H. DIXON,
Maintenance Engr.,
Radio Station Apia Samoa.

CAN YOU HELP?

Editor, RADIO NEWS:

It has occurred to us that some of your readers might be pleased to hear of the opportunity of providing a great deal of happiness and entertainment for the crippled children at the New York State Hospital by donating a radio set for their use.

The maintenance and expenses of running the hospital are provided by the State of New York, but while a radio set would indirectly help the children physically, we do not feel that the tax payers should pay for one.

About one-third of our 183 patients are in bed, and this is an unusual opportunity for large hearted people to bring joy to these little ones. While their treatment is prolonged on account of the condition from which they are suffering, they are all normal mentally and will leave here to make their own way in the world.

Yours very truly,
JESSIE A. SMITH,
Secretary to the Superintendent.
N. Y. State Hospital,
West Haverstraw, N. Y.

ELIMINATING INDUCTION FROM POWER LINES

Editor, RADIO NEWS:

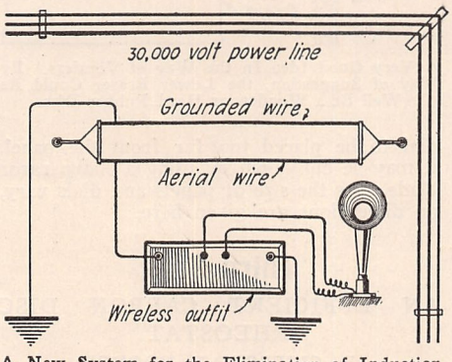
I have read from time to time the helpful hints and other useful things in your magazine. I have had an interesting experience that I think might be of help to other readers.

A few weeks ago the company I work for received from a high school a letter asking to have a wireless set demonstrated. I was sent to the school with the understanding that the school would buy the set if it would work. At the time I thought it was strange that the school should doubt whether it would work or not.

When I had the set all fixed up I called in the principal and confidently told him that he was going to hear a wonderful concert. I really should have tried it first, alone, because all the concert I could get was a loud hum and a few straggling sounds that might have once been music. I had the loud speaker turned on full directly from the fourth stage and you may be sure that it did not make a very good impression. The principal left the room and said that if I had it going right I could find him in his office.

The July Issue of SCIENCE and INVENTION Will Be A SPECIAL RADIO NUMBER. Be Sure You Do Not Miss It.

LOADING THE RECEIVER FOR LONG WAVE-LENGTHS
By Armstrong Perry
BROADCAST STATION PHOTOS
PRACTICAL POINTS ON REFLEX AMPLIFIER CONSTRUCTION
By Robert E. Lacault
A POCKET RADIO SET
By Clyde J. Fitch
AWARDS TO WINNERS IN "SIMPLEST BINDING POST CONTEST"
A ONE-TUBE SUPER-REGENERATOR
By Marius Logan
SINGLE TUBE RADIO CONTEST—$200.00 IN PRIZES
A DIAL CONTROL RECEIVING CABINET By Bert T. Ferencz
GENERAL RADIO CONSTRUCTION ARTICLES AND HINTS
REFLEX CIRCUITS SAVE TUBES
By A. P. Peck



A New System for the Elimination of Induction from Power Lines.

I worked all day trying to eliminate the hum, without success. I discovered that there was a 30,000-volt power line a short distance away and as the line turned at right angles it would be impossible to run my aerial at right angles to it.

I phoned back to the office, and after a short time received new instructions. I was to run a single wire, 150′ long, at right angles to one part of the power line. When I had that done, I was to run another line parallel to the first one. I then had a two-wire aerial, 150′ long, parallel to one part of the power line and at right angles to the other part of it. The power line that paralleled the aerial was on the north side, so I simply grounded the north wire, and used the south one for my aerial.

It was now evening of the second day. I asked the principal to visit the school that evening to listen to another concert. He didn't have much faith in it, but just the same he came. This time I had tried it alone and knew that it would work well. The principal was well pleased with the results and then he told me that he had had three other companies install outfits there before he came to my company. The others failed to make their sets work, so the school did not buy them. As I made my set work the school bought it, and was very glad to get a set that would work; I also was very glad to have succeeded in my first business venture.

CHARLES FLANDERS.
Berkeley, Cal.

SOMETHING WE LEFT OUT

Editor, RADIO NEWS:

In the article "Results of $500 prize contest, etc.," in February RADIO NEWS, due to an omission on your part, you made a gross misstatement which could react to the detriment of the amateur. You claim that as the only things which are done by the amateur are relaying, trans-atlantic transmission, occasional assistance to the police and helping the country during the late war, that the real usefulness of the amateur is nil "if the amateur is honest with himself." The omission was of the mention of work done by amateurs during storms which blew down telegraph and telephone wires. During November stations 7ZO and 9ZAF, together with 9ANQ and AD7, gave assistance to a middle western railroad when two passenger trains were stuck out in the country in a blizzard, with wires down. Similar work has been done in all storm afflicted areas of the United States and Canada by amateurs every year since the war.

It may be true that amateurs cannot rest on past laurels, but this is not necessary. The recent war came at a time when no person expected it. A new war may break out any day now, as it is practically certain that another war will be necessary to settle difficulities arising out of the preceding one.

Do not lose sight of this:

The amateur is on the job all the time, so to speak, and when the emergency comes, he is ready to step in and help with his station, on a moment's notice, so that the statement that "the real usefulness of the amateur is nil, if the amateur is honest with himself," is a most erroneous one.

You mention that you did not intend to convey the idea that the amateur was doomed on account of his interference. Now, while I am glad to hear this, I must confess that the impressions of all those to whom I have spoken on the subject, as well as my own, were to the effect that you did wish to carry this idea. What, then, is, or was, the amateur doomed to?

In a nearby city we have a person who, we understand, sells receiving sets; he built for himself a big honeycomb receiver. When he has a bunch in listening to the broadcasting, if it is after 10:30 p. m., he squeezes the primary and secondary together so as to get the mush from local C.W. stations

(*Continued on page* 70)

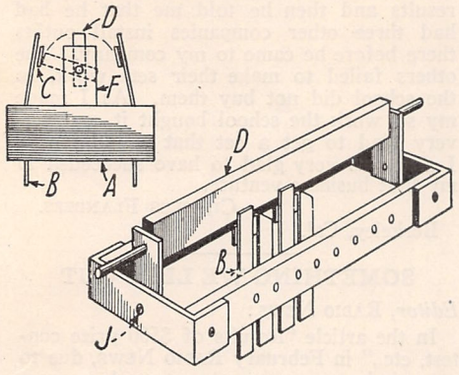
Awards Of the $50 Radio Wrinkle Contest

First Prize

A DOUBLE-THROW FOUR-POLE ROTARY SWITCH

By JOSEPH H. THOMPSON

This switch is for the use of amateurs who have not much money to spend on the different parts necessary for a radio set, in which class I belong. This switch works perfectly on my set. It can be put to any number of uses such as switching, from a short to a long wave receiving set or for switching from detector to one or two stages of amplification. It consists of a few pieces of insulation material together with a small quantity of brass stripping and a few screws.



An Easily Constructed Switch That Will Serve Any Number of Purposes. It Has the Advantage of All Contacts Being Stationary.

The different pieces are lettered in the drawing: D and G are pieces of insulating material such as hard rubber, bakelite or any other similar insulation. A and F are pieces of brass, B and C are also of brass but of the spring type. H is a small brass rod for shelf D to rotate on. No dimensions are given in the drawing, for the nature of the instrument does not require any particular specifications. It can be built to any size desired so as to conform to any particular use that it may be put to. B and C are used as contacts; there are eight of these on each side of the switch, screwed separately on the arms G. These are bent toward the rotating arm D so that when it is turned, it will press spring C against spring B to make firm contact. As seen, the upper parts of springs C are bent at an angle so that they extend in front of the upper portion of springs B. This bend may easily be accomplished with a pair of pliers. The rest of the construction is easily determined, as the drawing is self-explanatory.

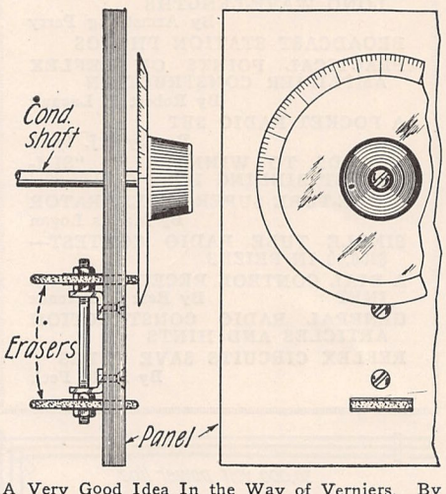
Second Prize

A RUBBER TIRED VERNIER ATTACHMENT

By SIDNEY BAMFORD

This vernier can be used in conjunction with condensers, variometers, tickler coils or any other apparatus requiring a fine adjustment and controlled by a dial. The materials required for the construction of this vernier are: two 5c. round erasers, (with metal centers) one brass rod threaded at both ends with necessary nuts. The threaded rod should be of such a diameter that it will slip easily through the holes in the erasers. Two right-angle brackets drilled for the rod and machine screws are used as shown in the sketch, and two 6/32 flat-headed machine screws and nuts to fit same. The drawing clearly shows the idea of construction, but a few words will not be out of place. A slot slightly larger than the width of the eraser is cut in the panel at a convenient distance from the bottom, say between ½" and 1". This slot should be long enough to allow the eraser to protude about ⅜" without rubbing the sides of the slot. Then, in line with this slot, a similar one is cut in the panel, behind the dial and near to its edge, as shown in the sketch. Holes to mount the angle brackets are drilled and countersunk to accommodate the flat-headed machine screws.

The erasers are held in place by locking one nut against another on the shaft. If the upper eraser is too large and causes the dial to be placed too far from the panel, it may be cut down by using a sharp razor blade. As the size of panels and dials vary, no dimensions are given here.



A Very Good Idea In the Way of Verniers. By Way of Suggestion, the Lower Eraser Could As Well Be a Wooden or Hard Rubber Disc.

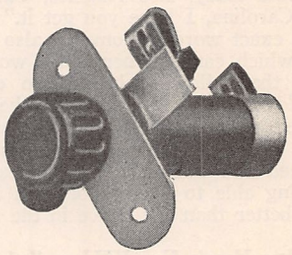
Third Prize

AN EFFICIENT CARBON DISC RHEOSTAT

By CLIFFORD E. MOONEY

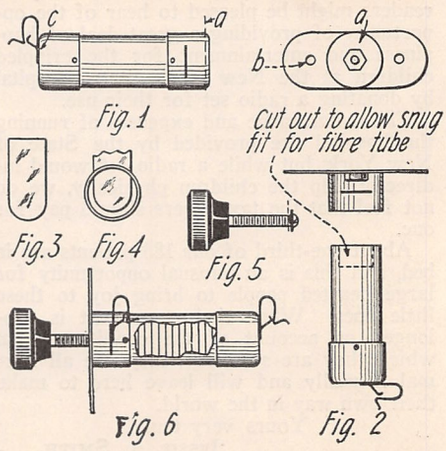
In constructing a receiving set for experimental purposes to plans published in a recent issue of RADIO NEWS, the writer had a desire to use a carbon disc rheostat for filament control. Not wishing to purchase one of the numerous types on the market, the following idea was conceived and a rheostat constructed accordingly, which was tested very rigidly and gave excellent results.

A non-refillable fuse of the cartridge type (30-60 amp.), with the ferrules secured to the fibre tube by small brass tacks was procured and one end sawed off as in Fig. 1-a. The filling material and remaining parts of the fuse link were next removed and a Fahnestock connector soldered on, as in Fig. 1-c. After cutting off ferrule 1-a, the ferrule had best be removed for subsequent soldering, etc., as the heat used will burn and char the tube. A saw cut is made ½" long (Fig. 1-b), to admit flat spring piece (Figs. 3 and 4). This was made out of a piece of brass socket shell nicely flattened and cut to shape. Solder in as shown in Fig. 4. A piece of brass (Fig. 2) 2½" long x ⅞" wide and about ⅛" thick is next secured. The ends can be rounded or squared as desired and three holes drilled, all to clear an 8/32 brass screw. One is drilled in the exact center, the other two, ¾" each away from the center hole. An 8/32 brass nut is now centered over center hole and sweated on. The ferrule is next placed on this piece centrally located and soldered fast with the nut inside. Another Fahnestock connector is soldered to a flat spring piece, Fig. 3, also shown in Fig. 4. One side of the fibre tube is cut out on the end as shown in Fig. 2, to allow the fibre tube to fit up over the brass spring. Next, a knob from an old rotary snap switch is secured and an 8/32 screw is put in as tightly as possible and the head is cut off, see Fig. 5. This should be left long enough to pass through your panel and work against the spring piece, Fig. 4.



The Carbon Disc Rheostat As It Appears When Finished.

A number of discs about ⅛" or 3/32" thick are cut from a ½" hard round carbon, such as are used in arc lights, and these discs are nicely sanded and worked to uniform thickness. Cut and finish enough to fill the tube so that with the tension relieved the brass spring will make contact with the carbon discs when the front ferrule is replaced. One or two discs may have to



Constructional Data On the Carbon Disc Rheostat. All Measurements Conform To the Size of the Fuse Cartridge Used.

Prize Winners

FIRST PRIZE, $25

A Double-Throw Four-Pole Rotary Switch

By JOSEPH H. THOMPSON,
1 Graves Ave.,
Northampton, Mass.

SECOND PRIZE, $15

A Rubber Tired Vernier Attachment

By SIDNEY BAMFORD,
83 Lake Street,
Hammondsport, N. Y.

THIRD PRIZE, $10

An Efficient Carbon Disc Rheostat

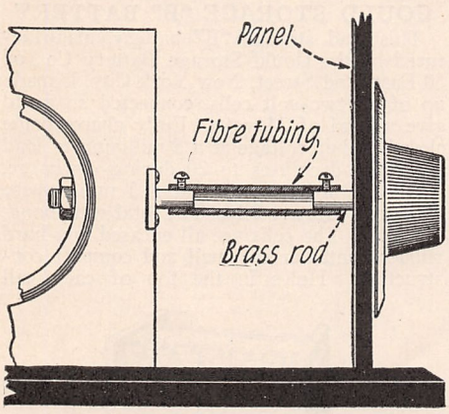
By CLIFFORD E. MOONEY,
Fredonia, Kansas.

be cut slightly thicker to make up properly. A little experimenting in this particular detail will soon determine the proper number of discs to be used. After assembling, the brass tacks are cut off to just fit through holes in the ferrule and into the fibre tube and the unit is ready for mounting. Fig. 6 shows a sketch of the complete assembly. As is generally known, the more pressure on the discs the smaller the resistance offered and vice-versa. The writer tested this piece of apparatus in every conceivable way and it is now giving service equal to, if not better than most of the rheostats on the market. A little care and patience will well reward anyone who wishes to construct this rheostat, and the cost should not be more than a few cents. The writer is an electrical engineer, afflicted with the radio bug of course, and had access to a quantity of discarded fuses, sockets, carbons, etc., and the only cost was just what he would consider his labor. Almost anyone can secure enough material around home or from the junk box of the local electrician to build this little instrument.

AN INSULATING SHAFT FOR VARIOMETERS

Certain types of variometers and variocouplers, and all types of condensers (variable) are so constructed that the shafts are "live"; that is to say, they are used to carry the current from the windings (or plates) to the binding posts on the instrument. With this form of construction the capacity effect caused by the proximity of the operator's hands to the dials is very pronounced, and cannot be remedied by shielding the panel. This will be understood when it is seen that the live shaft on which the dial is mounted passes through the panel, with the result that the shaft is not protected by the shielding.

To overcome this defect the following idea was originated. As will be seen from the accompanying drawing, the variometer was placed as far back from the panel as the size of the cabinet would allow, in this case about three inches. A piece of fibre



If the Shafts of Your Instruments Are Too Short, or If You Are Troubled by Body Capacity Effects, Try This.

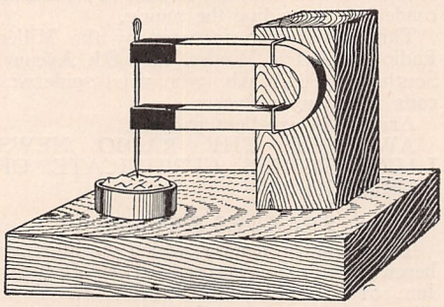
tubing was then obtained with an inside diameter equal to the diameter of the variometer shaft. One end of this was slipped over the shaft, and kept in place by means of a set screw, as shown in the drawing. Into the other end of the tubing was then inserted a piece of round brass rod, of the same diameter as the shaft, and about an inch and a half long. A set screw was used to keep this rod firmly in place in the tubing. The rod was then adjusted so as to project through the panel to the distance required to accommodate the dial, and the two set screws tightened up. The hole in the panel should be exactly in line with the shaft, and of such size that the brass rod will just slip through it; this forms a third bearing for the shaft, and precludes the possibility of the latter wobbling.

If this scheme is used in connection with a shielded panel there will be absolutely no capacity effect noticeable from the operator's hands, and tuning will be, therefore, much simplified. The fact that the variometer is well set back from the panel, helps to further reduce any possible capacity effects that might exist between the variometer windings and the hand of the operator. This may exclude the necessity of shielding the panel. Condensers and couplers may, of course, be threaded in the same way.

Contributed by A. H. Whitehouse.

A MAGNET DETECTOR

This simple magnet detector may be made by any radio fan in a few minutes. A block of wood 2" high and ½" thick is glued to the base of the set. To the wooden block



Here is a Clever Arrangement in the Way of Crystal Detector. The Horse-Shoe Magnet Holds the Needle in Any Desired Position.

is attached a toy magnet. Ordinary wire staples will hold it in place. The extremities of the magnet are placed directly above the crystal. An ordinary sewing needle is placed against the magnet which, of course, is held in place by attraction. The needle can be moved along the side of the magnet to find the most sensitive spot on the crystal. Galena crystals require the lightest of pressure and it can readily be seen that the magnet detector will allow less than the weight of a needle to touch the sensitive material.

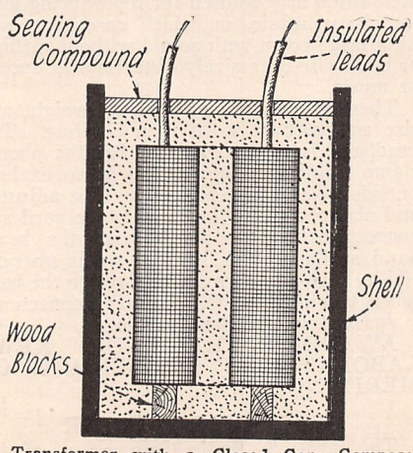
One connection is made to the curved end of the magnet while the other is taken directly from the crystal mounting.

Contributed by Jack DeWitt.

CORES FOR TRANSFORMERS

I have found that in building transformers and chokes, the core often causes more trouble than the windings. Whatever material is at hand must be used or expensive electrical sheet bought and cut. If ready-made core is used the windings must be made to "go in the space," often at a sacrifice of capacity. When used in radio work, sheet or wire cores can also cause trouble, strong lines of force traveling between transformers or chokes.

The solution of most of these difficulties is



A Transformer with a Closed Core Composed of Powdered Iron. This Helps to Simplify the Matter of Construction.

the use of powdered iron cores. This suggestion may at first sound preposterous, because of the apparent impossibility of obtaining the powdered iron for such a core; but in reality it is a simple matter, an excellent substitute for the unobtainable powdered iron being found in any machine shop, structural iron shop, or garage, this being the fine grindings from the abrasive wheels. While this material may be ground from hard steel it is really very soft due to cooling from white heat at the wheel to normal at the floor.

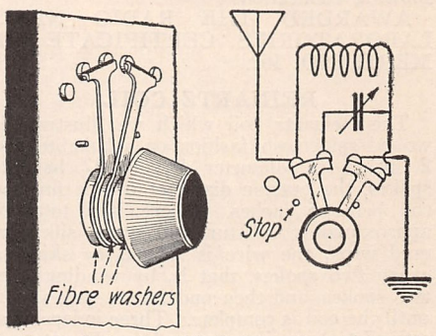
This material has all the advantages of powdered iron and is far superior to sheet and wire core with the added advantage of low cost, most shops throwing it out as scrap. But above all, it is efficient, it fits the space meant for it, and it prevents stray flux.

To make use of this type of core it is only necessary to see that the coils wound about a fair sized central opening are of a size to leave at least ¼" space between them and the case on all sides, that they are firmly wound, well taped and impregnated with well insulated leads brought out. This unit is then placed in the shell, the end resting on two small blocks of wood which provide space for the core to completely enclose the coil. The shell can be a small tin can or a hard rubber, bakelite or fibre tube plugged at one end. The filings, which have been previously dried to remove all oil and moisture, are then tamped in around and on top of the coil, entirely surrounding it with a perfect path for the magnetic circuit. When the core has been well packed melted paraffin or other sealing compound is poured on and allowed to soak in, which completes the assembling of the transformer or choke.

This type of core adapts itself readily to any kind of coil that the experimenter may have occasion to build, and has been tried out successfully on radio chokes and transformers and even on small welding transformers, living up to expectations in every case.

Contributed by Charles B. Neill.

A CONVENIENT SERIES-PARALLEL SWITCH



A Good Series-Parallel Switch That Takes Up but Little Space on the Panel. The Two Contact Arms Are Insulated from Each Other by Fibre Washers.

One variable condenser will do the work of two when used with a series-parallel switch, easily made from the ordinary knob and switch points used for the coupler circuit.

In one position, the switch connects the condenser in series with the antenna circuit and in the other position it connects the condenser in parallel with the aerial inductance. The first position has the effect of shortening the natural wave-length of long aerials so that broadcast programs can be more readily picked up, or changing the broadcast receiver into a code receiver for amateur wave-lengths. The parallel connection tends to increase the natural wave-length and to make tuning sharper.

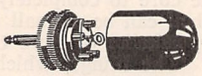
In addition to the five switch points it is necessary to make two switch blades, each wide enough to make contact with two of

(*Continued on page* 97)

Apparatus Awarded Certificates

FOUR WAY SWITCH PLUG

A very ingenious switch plug embodying a departure from the conventional design is manufactured by the Four Way Company, of Springfield, Mass. This plug, although not much larger than the regular telephone plug, has connections for either two phones, two loud talkers, or one loud talker and one pair of phones. A unique switching arrangement with which, by merely turning the handle, either one or the other head set or loud speaker can be switched into the circuit



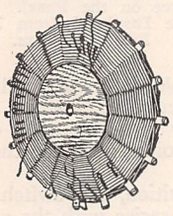
independently, or the two can be connected either in series or parallel with each other. The connections are indicated with white enamel on the plug. The phone cords may be anchored to a metal ring inside of the plug so that jerking the cords will not pull on the tips. Four spring contacts which are connected to the four phone tips make connection to two metal segments mounted on the front part of the plug. By turning this part of the plug the different connections are made. A notch is made in the compound between the metal segments so that any metal deposited on the insulation from the rubbing of the spring contacts will not short circuit the segments. This plug is of very good mechanical construction.

Arrived in excellent packing, with circular showing connections.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 162.

REINARTZ COIL

The Reinartz coil which we illustrate is wound spiderweb fashion on a bakelite disc 2 inches in diameter having 17 bakelite spokes, the outside diameter of the finished coil being 5 inches. There is a total of approximately 130 turns of green silk covered wire; the wire is wound by skipping every two spokes, that is, by winding over two spokes, and then under two spokes, etc., until the coil is complete. Three independent sets of tap connections are brought out: one



set for the antenna circuit, one set for the grid circuit, and one set for the plate circuit. With a .0005 M.F. variable condenser connected across the maximum number of turns available in the grid circuit section of the coil, which is the size of condenser which should be used on this type of coil, the maximum wave-length was 350 meters. This was reduced to 250 meters with the condenser at the zero position. Wave-lengths lower than 150 meters can be reached by means of the taps. The coil would allow for regeneration and oscillation throughout the entire wave-length range. A hole through the center of the wooden disc provides for mounting. The compactness of the coil makes it highly desirable, as no other coils are required in the circuit, two variable condensers providing the tuning.

This coil is manufactured by the Miller Radio & Electric Works, 4103 8th Avenue, South, Seattle, Wash., who wind spiderweb coils for many purposes.

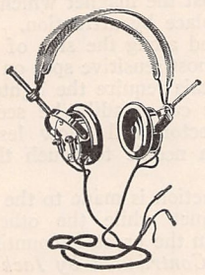
Arrived in excellent packing.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 163.

BRANDES PHONES

The telephone headset which we illustrate herewith is manufactured by C. Brandes, Inc., of 237 Lafayette Street, New York. This headset is well known as their MATCHED TONE receivers, and our tests indicated that they are all that the name implies.

Connected to our audibility meter, we find that the greatest sensitivity of the phones lies between frequencies of 400 and 4500 cycles per second. The greatest sensitivity



is in the neighborhood of 750 cycles. These limits cover practically all of the frequencies of the human voice and musical instruments. The sensitivity is nearly constant within this range, which is desirable so as to avoid distortion. The sensitivity increases rapidly from 200 to 400 cycles where it remains nearly constant from 400 to 2000 cycles and then gradually decreases up to 4500 cycles and falls off at higher frequencies. There is a resonance frequency at about 5500 cycles. Compared with other phones of the best make now on the market, these phones rank well at the top as regards sensitivity, and in addition may be used for reproducing loud speech or music, in which case they will fill a large room with sound without rattling or otherwise excessively distorting the speech or music.

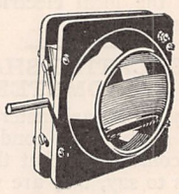
These phones are of medium weight and size and may be worn with comfort. The headband is so designed so that the phones clamp tightly on the ears so as to exclude outside noise. The phones may be adjusted and clamped to fit the head. The cord and connections are insulated from the headband and metal shell so there is no possibility of receiving a shock through the head when touching the "B" battery connections.

Arrived in excellent packing.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 164.

F. R. S. VARIOMETER

The F. R. S. Radio Corporation, of 407 E. Fort Street, Detroit, Mich., have submitted for test their variometer which we illustrate herewith. This variometer is of moulded construction of a very convenient form and presents a pleasing appearance. When connected to the grid and filament of a vacuum tube in series with a standard variocoupler secondary coil the wave-length range was from 190 to 475 meters, which indicates that the inductance ratio of the



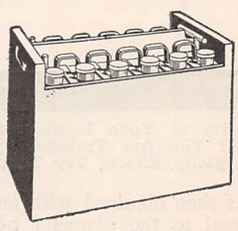
variometer from minimum to maximum is very high, which is desirable in this type of apparatus. The shafts are ¼ inch in diameter and pass through heavy metal bearings giving a smooth rotary movement and positive electrical contact. Tapped holes in the front metal bearing allow for mounting on a panel. The rotor is accurately mounted and is designed to have a minimum distance between windings, which accounts for the high inductance ratio. The windings are of green silk covered wire.

Arrived in excellent packing.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 165.

GOULD STORAGE "B" BATTERY

This lead storage "B" battery, manufactured by the Gould Storage Battery Co., of 30 East 42nd Street, New York City, is made up of 12 two-volt cells, connected so as to give a total of 24 volts. Fully charged, the closed circuit voltage at a 5 milliampere load is 25 and decreases to 20 during discharge. The total ampere hours at a 5 milliampere discharge rate are 3.15. The total watt hours are 75.54. The cells are all encased in a hard rubber container of small and compact construction. Holes in the top of each cell



allow for testing the density of the electrolyte with a hydrometer and also for adding distilled water to compensate for evaporation. Small rubber caps with ventilating holes fit over openings and prevent foreign matter from falling into the electrolyte. Lead terminals are brought up through the tops of the cells. The individual cells are connected together with lead links, which allow taps to be connected to any cell, thus obtaining voltages in steps of two volts up to 24. The outside dimensions of the battery are 4½" high by 3⅞" wide by 6¼" long.

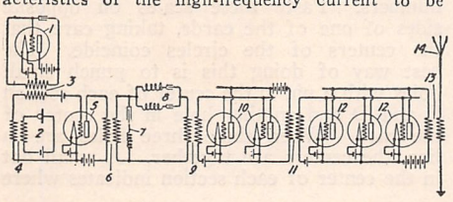
Arrived in excellent packing.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 166.

SYSTEM OF TELEPHONY

(Patent No. 1,449,372. Issued to Harold D. Arnold, of East Orange, N. J., March 27, 1923.)

This invention relates to a method of and apparatus for signaling, by means of modulated high-frequency waves or currents. Very specifically, its object is to increase the efficiency of telephonic communication by modulating a high-frequency modulation, and eliminating from the antenna or other sending circuit constant amplitude oscillations of the carrier-wave frequency which in present practice are impressed upon it. Further objects are to improve the quality of speech received, and to make possible the secret transmission and reception of messages. These objects are accomplished by providing an arrangement of circuits whereby current is suitably modulated and is supplied to the antenna only when the characteristics of the high-frequency current to be

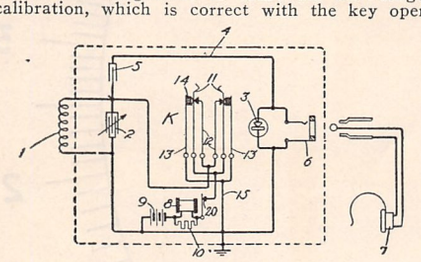


impressed on the antenna are changing, in accordance with the wave form of the signal to be transmitted, and by providing at the receiving station a small auxiliary regenerator, which shall furnish a wave of the frequency of the unmodulated carrier-wave. Although this invention has been described in connection with a phone system, it will be obvious to those skilled in the art that its use is not so limited, since, as is well known, telegraphic and other means of signaling involving modulation and high-frequency current are fundamentally the same in principle as carrier current telephony. It is also obvious that this invention is applicable to systems employing a conductive transmission circuit as well as to radio systems.

WAVE METER AND SIMPLE ELECTRICAL DEVICE

(Patent No. 1,448,575. Issued to George H. Stevenson, of Rye, N. Y., March 13, 1923.)

This invention relates to wave-meters and a simple electrical apparatus and, more particularly, to means whereby the frequency calibration of such apparatus will not be rendered incorrect by the opening or closing of a key connected to the circuits of the apparatus. It has been found that the key, which serves to connect the buzzer into the circuit, has a capacity between contact blades of sufficient magnitude to cause the wave-length calibration, which is correct with the key open,



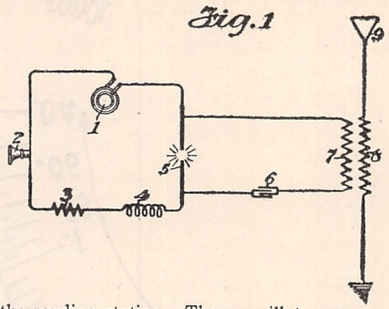
to be incorrect when the key is closed, or vice versa. This happens because the effective capacity of the key blades is in shunt with the tuning condenser of the tuned circuit when the key is opened. This capacity, in a particular instance, is of the order of 10 x 10-12 farads. A capacity of this magnitude produces appreciable effects at radio frequencies. By placing additional insulated blades 14 on the key and connecting these additional blades in circuit, so that, when the key is closed, their capacity will be substituted by the condenser 5 for the effective capacity induced by the contact blades, when the key is opened the calibration may be made correct for either operative condition of the apparatus.

SYSTEM OF ETHER WAVE CONTROL

(Patent No. 1,447,779. Issued to John Hays Hammond, Jr., of Gloucester, Mass., March 6, 1923.)

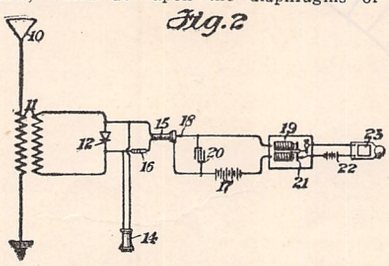
This invention applies to a system of ether-wave control. In the operation of this system, when the human voice or other sound-producing means actuates the diaphragm of the microphone 2, located at the sending station, there will be a corresponding change in circuit characteristics of the oscillating waves propagated from the aerial

Fig. 1



of the sending station. These oscillatory waves are received by the aerial 10 of the receiving station. So long as the microphone 2 is at rest, the train of waves emitted from the aerial 9 will be of a constant and undampened character and cause, by their high frequency of oscillation, the currents induced by them, to pass through the rectifying detector 12 in a series of rapid impulses of uniform direction and intensity. Owing to the inertia of the diaphragm of the phone receivers 14 and the relays 15 and 24, these extremely rapid impulses of rectifying current do not cause any appreciable vibration of the diaphragms and, consequently, no sound will be heard in the phone receivers 14. The effect of these extremely rapid and weak impulses is not sufficient to open the contact device 18 of the relay 15, of Fig. 2. When the diaphragm of the microphone 2 is actuated by sound waves, such, for instance, as the human voice, variations in accordance with these waves are produced in the amplitude or intensity of the oscillations transmitted by the sending station, and these cause corresponding variations of the amplitude or intensity of the resultant impulses, which act upon the diaphragms of the

Fig. 2



receiving station and, consequently, these are vibrated in accordance with the sound waves thus transmitted from the sending station, and corresponding sounds may be heard in the receiving phones 14. This vibration of the diaphragm of the relay 15 of the system shown in Fig. 2 causes a rapid and repeated opening and closing of the contact device 18, and a corresponding rapid and repeated opening and closing of the circuit through the battery 17, which causes the release of the armature 21 of the relay 19, and a consequent closing of the circuit through the battery 22 and electric bell 23, or other device.

DETECTOR

(Patent No. 1,445,613. Issued to Harold Potter Donle, of Meridan, Conn., February 13, 1923.)

Fig. 1.

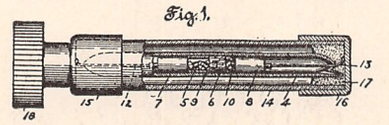
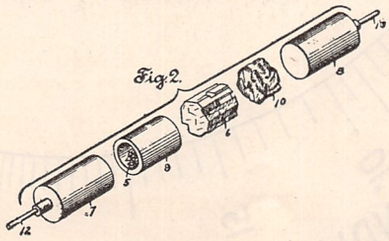
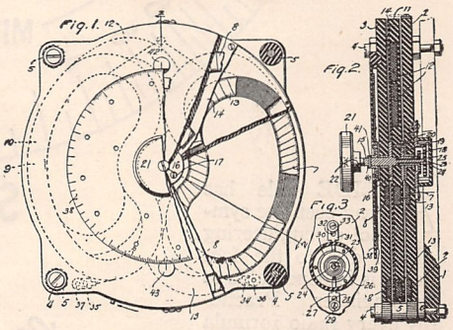


Fig. 2.



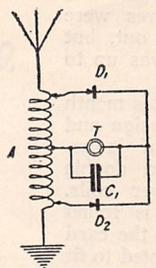
The primary object of this invention is to provide a sensitive, easily adjusted, and dependable contact-type detector for radio signaling. By evacuating the chamber in which the active contact is located, there is not only avoided the possibility of deleterious action upon the sensitive portions of the detector, by moisture, dust or fumes in the atmosphere, but it does away with the oxidation which in other contact detectors, after a few weeks or months, reduces the sensitiveness, and which renders their action unreliable. The sensitive couple in the form shown by Figs. 1 and 2 consists of metallic particles 5 and a so-called crystal or non-metallic substance 6. The particles 5 are preferably of substantial size, and may be termed granules. They are also preferably of irregular or angular shape. The element 6 may be one of the well-known materials used in self-restoring contact detectors, such as commercial silicon, galena, iron pyrites, natural oxide of zinc, etc. These elements are mounted in the tube, between the terminal plugs 7 and 8. The fixed or stationary active electrodes 6 may conveniently be spaced apart from the terminal 7, by means of a sleeve of glass, or other insulating material, 9.



VARIABLE INDUCTANCE ELEMENT

(Patent No. 1,445,242. Issued to William J. Shackelton, of Scotch Plains, N. J., February 13, 1923.)

This invention relates to variable electrical elements such as are used in determining unknown inductance methods of comparison. This invention, in its preferred form, is provided with three discs, having attached to them Reniform coils, i. e., coils having an outline somewhat in the form of the kidney bean. With this form of coil substantially all of the area of each disc is included within the coils embodied in that disc. The kidney bean form of coil is adopted since that form is the most practical to manufacture, as compared with other forms which may be used to include as great a proportional disc area, and because it gives a uniform scale. One great advantage of this form is, that the discs are of much smaller diameter for the same inductance value than would be used for the form of coil ordinarily employed. Another advantage is the fact that the change in inductance is, substantially, directly proportional to the angle to which the moving disc is turned, since, for a considerable length, the periphery of the coils is concentric with the center of rotation of the moving disc. This feature assists materially in the accuracy with which the instrument may be calibrated, as well as the accuracy with which the inductance values may be determined.



RADIO RECEIVING SYSTEM

(Patent No. 1,447,793. Issued to Marius Latour, of Paris, France, March 6, 1923.)

This present invention relates to improvements in circuit arrangements of radio telegraphic receiving stations, for the purpose of increasing the sensitiveness of the receiving, and making possible the application of the principle of heterodyne

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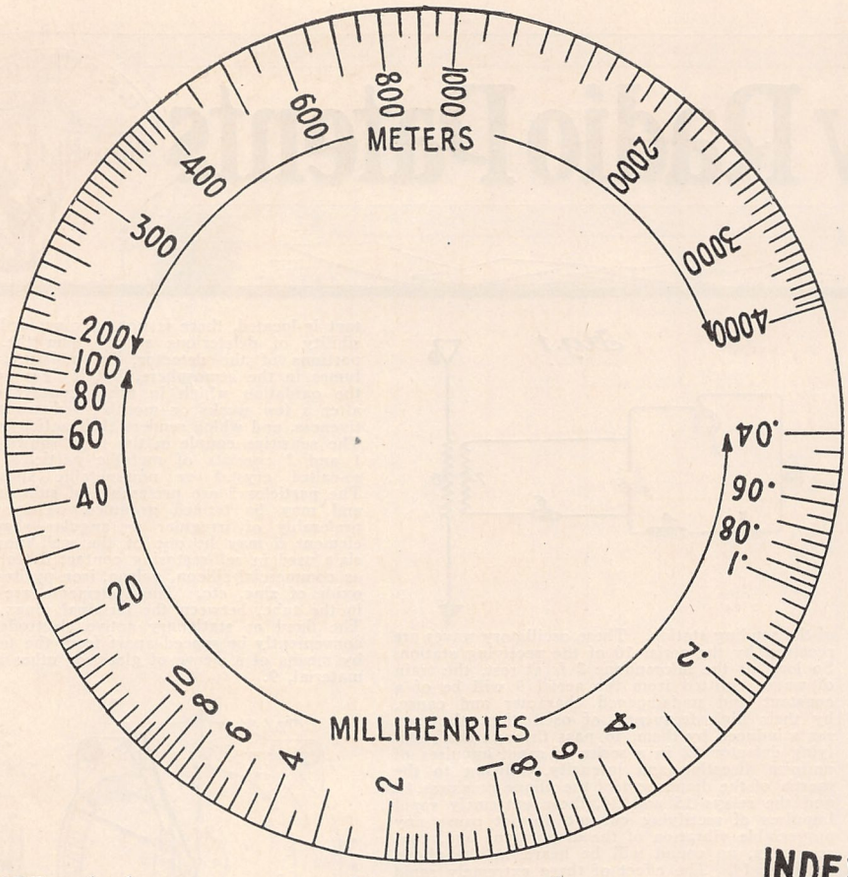
PRACTICAL SLIDE

By RALPH
AUTHOR OF PREPARED



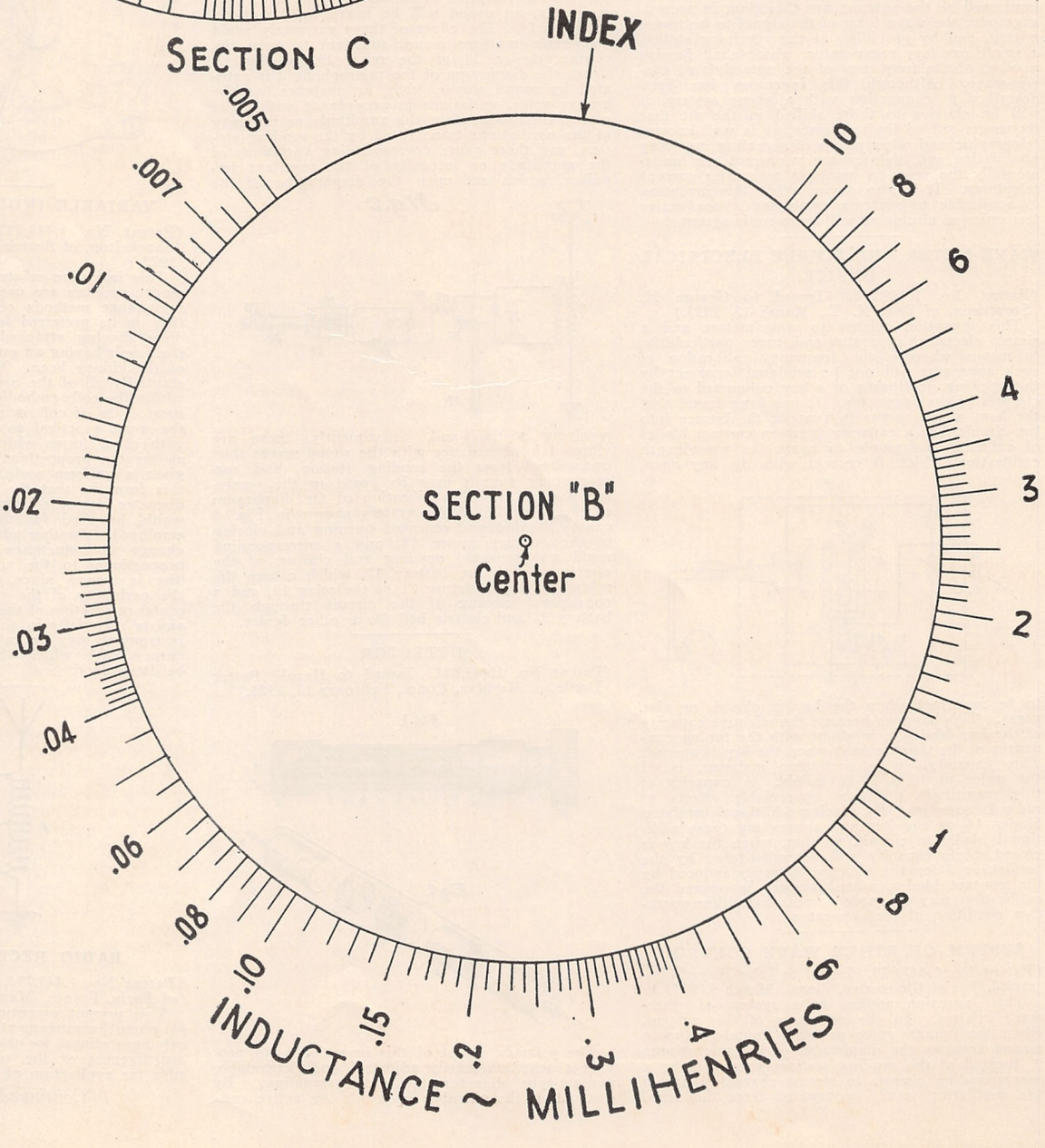
A SLIDE rule has long been the symbol of engineering science due to the fact that it is indispensable to the engineer. Practically every radio formula may be solved on a standard rule. However, to the novice who has only an occasional problem, the cost of such an instrument is unwarranted. Besides the first cost, considerable study and practice is necessary before the instrument is trustworthy and accurate. However, a slide rule designed to solve only one or two problems becomes very simple and easy to understand. It is with this in mind that the following scales have been designed, which may be cut out and pasted on a small card by the readers, to produce one of the easiest types of slide rules to construct —the rotary type. The scales themselves were harder to lay out, but this problem was up to the author.

The charts this month take up the design and measurement of inductance of single, double and triple layer coils. This problem is found on one side of the card and scales adapted to fit the reverse side of the same card will solve that ever present problem which is always before every radio experimenter. What wave-length will I obtain with a combination of this inductance and that capacity?

It may be mentioned that in either of these cases many variations of these problems may be solved as well. Thus if the diameter of the tube to be used in the construction of a coil is known, the inductance desired, and the size of wire to be used are also known; the chart may then be used to find out how long the winding should be.

CONSTRUCTIONAL DETAILS

Procure two smooth flat cards having their smaller dimensions somewhat larger than the largest of the following scales. For convenience the four scales will be called Sections A, B, C and D. First cut out sections B and D, in the form of a square, being careful not to trim away any of the numbers. Paste these scales on opposite sides of one of the cards, taking care that the centers of the circles coincide. The best way of doing this is to punch small holes with a pin in the center of each section B and D and another hole in the center of the card. When these three holes are in line, the centers are together. A small dot in the center of each section indicates where



RADIO RULE BATCHER

RADIO MEASUREMENTS

the hole should be punched. Dry card after pasting, under pressure between flat surfaces to prevent warping.

Paste sections A and C on opposite sides of the other card getting the centers together in the same way, and dry flat. When dry, carefully trim off the edge around section A outside of the circle, leaving no margin. This leaves a round disc with scales on each side. It will be found that Section C is a little smaller, but this is intentional.

Returning to the square card with sections B and D, cut out the two circular slots on section D indicated by the letters "s-t-u-v" and "w-x-y-z," cutting clear through the card. This operation is best done with a sharp knife. It is desirable to cut exactly on the lines and curves bounded by the above letters. The removal of these sections will not affect the scales on section B on the other side, since the latter is somewhat larger.

Then lay the rectangular card on the table with section B up. On top of this place the circular card with face A up, and fasten the two together with a small rivet or paper fastener eyelet inserted through the center holes. The smaller disc should be free to turn about the center. When this is done the Computer is completed. If it is constructed according to these plans, the outer diameter of section A should be even with the inner diameter of section B; and the scales of section C will show through the windows opposite the scales on section D.

In the next issue another Computer will be disclosed which will provide a solution for the determination of the maximum capacity of a variable condenser, and for the determination of the effective capacity when two condensers are connected in series.

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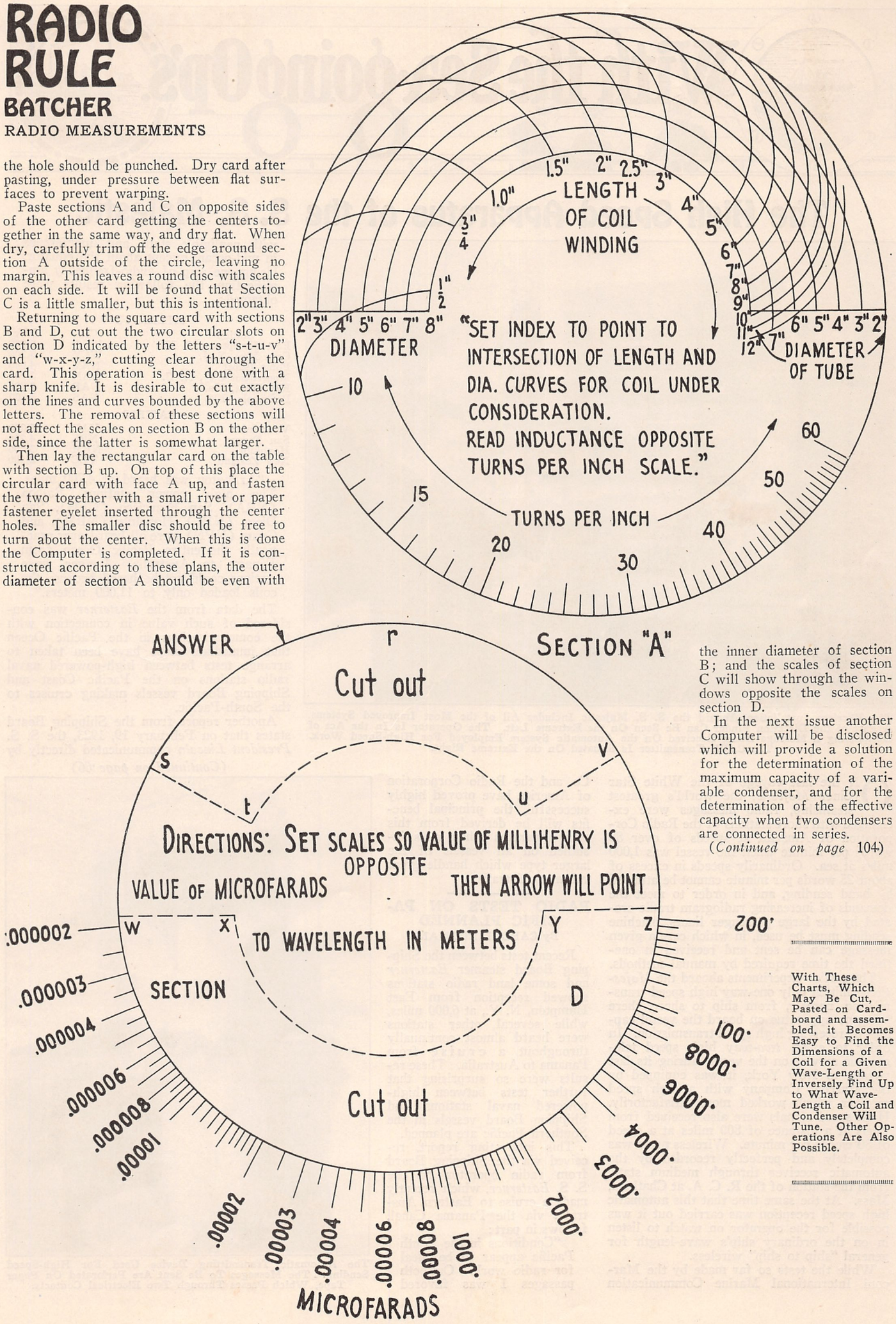
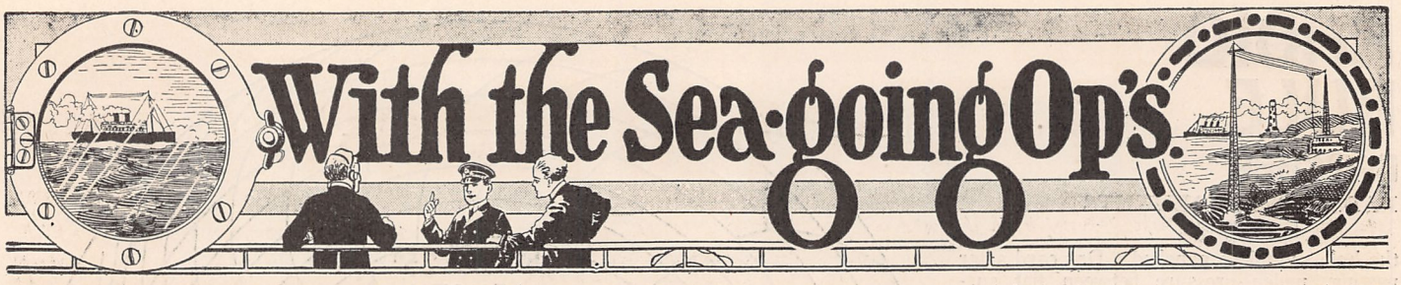
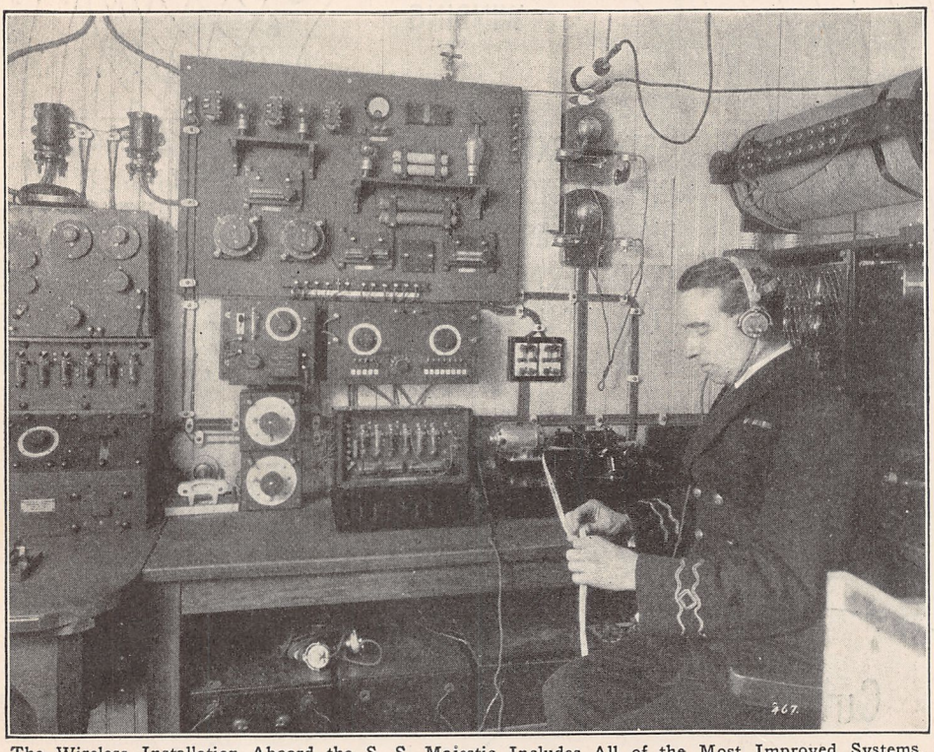


With These Charts, Which May Be Cut, Pasted on Cardboard and assembled, it Becomes Easy to Find the Dimensions of a Coil for a Given Wave-Length or Inversely Find Up to What Wave-Length a Coil and Condenser Will Tune. Other Operations Are Also Possible.



The High Speed Apparatus of the S. S. Majestic



The Wireless Installation Aboard the S. S. Majestic Includes All of the Most Improved Systems. A Part of the Direction Finder Can Be Seen On the Extreme Left. The Operator Is In the Act of Deciphering a Message Being Received On the Automatic System Employed For High-Speed Work. The C. W. Transmitter Is Situated On the Extreme Right.

ON the last voyage of the White Star Liner *Majestic*, the world's greatest steamship, radio messages were exchanged with shore stations of the Radio Corporation of America at speeds of over 80 words per minute when the vessel was 1,000 miles at sea. Ordinarily speeds in excess of about 25 words per minute cannot be attained by hand sending, and in order to meet the demands of increasing radiogram traffic created by the large passenger liners, machine sending must be used, in which case a given message can be sent and received in one-third the time required by manual methods.

The earlier experiments aboard the *Majestic* permitted only one-way high speed transmission, namely, from ship to shore, there being no apparatus on board the vessel capable of receiving high speed transmission. In order to effect *two-way* high speed telegraphic service on the vessel during its last voyage to New York, it was equipped by the Marconi Company with a high speed receiver which worked most satisfactorily. High speed signals were also received from Paris at a distance of 800 miles at a speed of 80 words per minute. Wireless press was completely and perfectly recorded by the automatic receiver through medium static from the station of the R. C. A. at Chatham, Mass. At the same time that this automatic high speed reception was carried out it was possible for the operator on watch to listen in on the ordinary ship's wave-length for general "ship to ship" wireless.

While the tests so far made by the Marconi International Marine Communication Co. and the Radio Corporation of America have proved highly successful, the principal benefits will be derived from this new apparatus when it is installed on all vessels of the larger type which handle great volumes of traffic.

RADIO TESTS ON PACIFIC PLANNED

By CARL H. BUTMAN

Recent tests between the Shipping Board steamer *Easterner* and some land radio stations showed reception from East Hampton, N. Y., at 6,000 miles, while several other stations were heard almost continually throughout a cruise from Panama to Australia. These results were so surprising that further tests between high-powered naval stations and Shipping Board vessels in the Southern Pacific are planned.

This interesting report, received via the Shipping Board from radio operator of the S. S. *Easterner*, which recently made a cruise to Eastern Australia via the Panama Canal, follows in part:

"Conditions in the South Pacific appear to be ideal for radio work. On both passages I was favored with negligible static and interference in mid-ocean, except about the equator. Using one step of audio-frequency amplification, the following results were obtained:

ATLANTIC

Station	Call	Miles
East Hampton, N. Y.	WSA	6,000
Cape May, N. J.	WCY	5,200
Point Isabel	NAY	4,000
Moorehead City, N. C.	NAN	3,100
Key West, Fla.	NAR	3,000
Pensacola, Fla.	NAS	3,000

PACIFIC

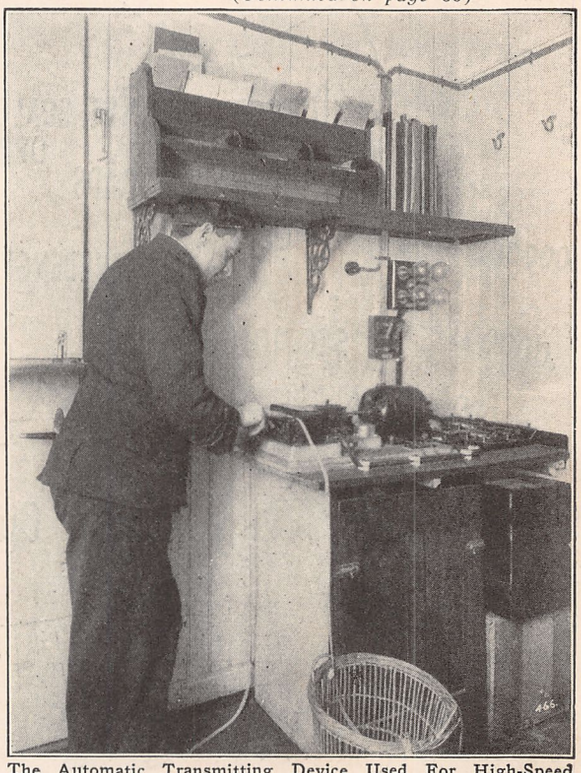
Vancouver	VAE	5,200
San Diego	NPL	4,200
Honolulu	NPM	3,400
New Zealand	VLC	2,500

"Arlington was heard at 4,200 miles. The high power stations Balboa (NBA), San Francisco (NFG), San Diego (NPL), Honolulu (NPM), and Guam (NPN) were all heard over practically the entire Pacific Ocean from Panama to Australia. Longer wave stations could not be heard because the coils loaded only to 11,000 meters."

The data from the *Easterner* was considered of such value in connection with the communications in the Pacific Ocean that immediate steps have been taken to arrange tests between high-powered naval radio stations on the Pacific Coast and Shipping Board vessels making cruises to the South-Pacific.

Another report from the Shipping Board states that on February 19, 1923, the S. S. *President Lincoln* communicated directly by

(*Continued on page* 66)



The Automatic Transmitting Device Used For High-Speed Sending. The Messages To Be Sent Are Perforated On Paper Tape, Which Passes Through Two Electrical Contacts.

THIS Department is conducted for the benefit of our Radio Experimenter. We shall be glad to answer here questions for the benefit of all, but we can publish only such matter as is of sufficient interest to all.

1. This Department cannot answer more than three questions for each correspondent.
2. Only one side of the sheet should written upon; all matter should be typewritten or else written in ink. No attention paid to penciled matter.
3. Sketches, diagrams, etc., must be on separate sheets. This Department does not answer questions by mail free of charge.
4. Our Editors will be glad to answer any letter, at the rate of 25c for each question. If, however, questions entail considerable research work, intricate calculations, patent research, etc., a special charge will be made. Before we answer such questions, correspondents will be informed as to the price charge.

You will do the Editor a personal favor if you will make your letter as brief as possible.

CORRECTION

In our May issue, in answer to Q. 658, a diagram was shown wherein a 120-watt lamp was inserted in series with a 32-volt lighting circuit to supply current to a detector tube. This should have been shown as a 40-watt lamp. A lamp of 120 watts, although correct for a 110-volt line, would pass too much current if connected in a 32-volt circuit. We wish to thank Mr. A. Schlesinger of the Western Electric Co., San Francisco, Cal., for calling this error to our attention.

R. F. HOOK-UP

(699) Mr. Andrew Smith, New York City, asks:

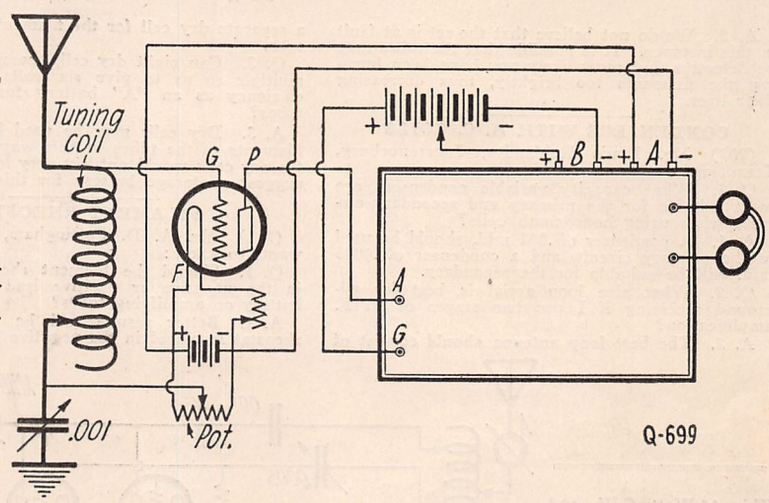
Q. 1. Can radio frequency be added to a standard three-circuit receiver without changing the wiring?

A. 1. This can be done by placing the radio frequency in front of the tuner, and using a separate tuning coil.

Q. 2. Please publish this diagram.

A. 2. This diagram will be found in these columns.

One Stage of R. F. May Be Added to a Standard Three-Circuit Receiver, as Shown Here. No R. F. Transformer Is Used, the Output of the Amplifying Tube Being Connected Directly to the Antenna and Ground Posts of the Tuner.



ANTENNA QUERIES

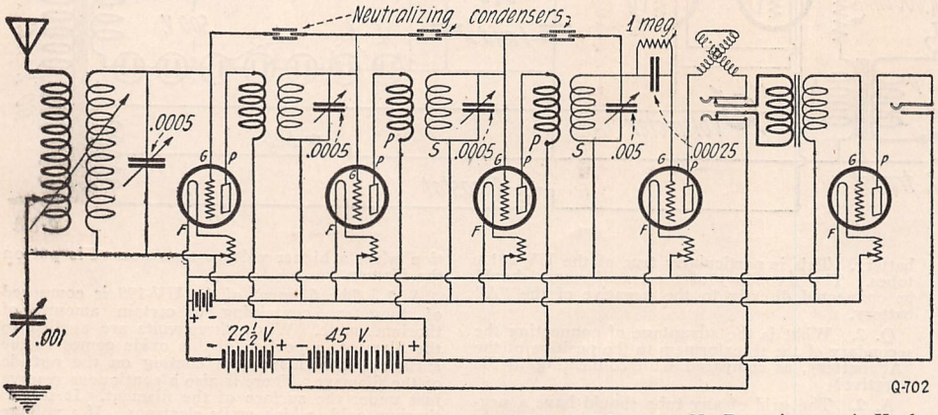
(700) Mr. Sigsmond Fillette, Natchetoches, La., wants to know:

Q. 1. For amateur receiving, will an aerial 40′ high give as good results as one 75′ high?

A. 1. Theoretically, the higher the antenna the better the reception will be. An antenna 75′ high would give very good results, but, if it is desired to receive on 200 meters, the horizontal part of the antenna should not exceed 60′. An antenna 40′ high and 100′ long will be very efficient, although the results obtained may not equal those obtained on the higher antenna.

Q. 2. Does the height of an aerial determine the receiving range?

A. 2. Very good results have been obtained on low aerials, but, as a rule, the higher the aerial, the greater the receiving range.



The Neutrodyne Receiver, Using Three Stages of Tuned R. F. Amplification. No Potentiometer is Used in This Circuit, the Secondaries of the Transformers Being Connected Directly to the Negative Side of the "A" Battery.

VARIOCOUPLER ROTOR

(701) Mr. W. P. Keller, Logansport, Ind., wants to know:

Q. 1. Would a set constructed as shown by K. Harkness, in the March issue of RADIO NEWS, work efficiently if the rotor of the variocoupler had the shaft running straight through, instead of at a 45-degree angle?

A. 1. The only difference this would make would be that the coupling could not be so easily controlled. Aside from this, the results would be the same.

NEUTRODYNE CIRCUIT

(702) Mr. Grey P. Stubbs, Jr., Monroe, La., asks:

Q. 1. Please publish the Neutrodyne Circuit, using three stages of radio and one stage of audio-frequency amplification.

A. 1. This circuit appears on these pages.

Q. 2. Where can the air-core transformers and neutralizing capacities be obtained?

A. 2. We suggest you write to the Freed Eisemann Radio Corporation, 251 Fourth avenue, New York City, manufacturers of neutrodyne receivers.

CONDENSER CAPACITIES

(703) Mr. A. P. Rabilo, New Orleans, La., requests:

Q. 1. Will you kindly publish the capacities of 23- and 43-plate condensers?

A. 1. These condensers are, approximately, .0005 and .001 mfd. capacity, respectively. This will vary a trifle one way or the other, according to the size and distance of the plates from each other.

PHANTOM CIRCUIT

(704) Mr. U. Roy Sewrey, Peru, Ill., asks:

Q. 1. Please publish the hook-up of the so-called Phantom Circuit.

A. 1. This circuit will be found in these columns. You will notice that this is simply a tuned plate receiver, using an antenna or ground only.

ELECTROLYTIC RECTIFIER

(705) Mr. L. F. Berhenke, Lena, Ill., asks:

Q. 1. I would like to know if a battery of more than 60-ampere-hours capacity can be charged with the electrolytic rectifier described in the March issue of RADIO NEWS, by the addition of a transformer.

A. 1. A battery of any capacity may be charged with this rectifier, providing the rectifier is allowed to charge long enough. A transformer is not used in any way with this rectifier.

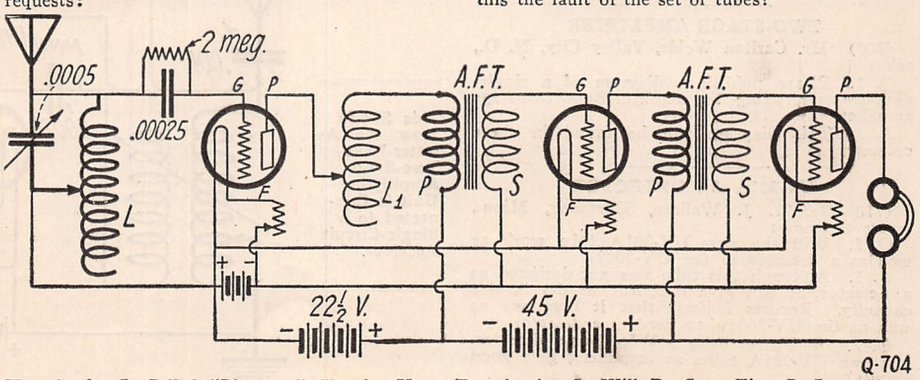
SINGLE-TUBE REFLEX

(706) Mr. E. Hartford, Steubenville, Ohio, desires:

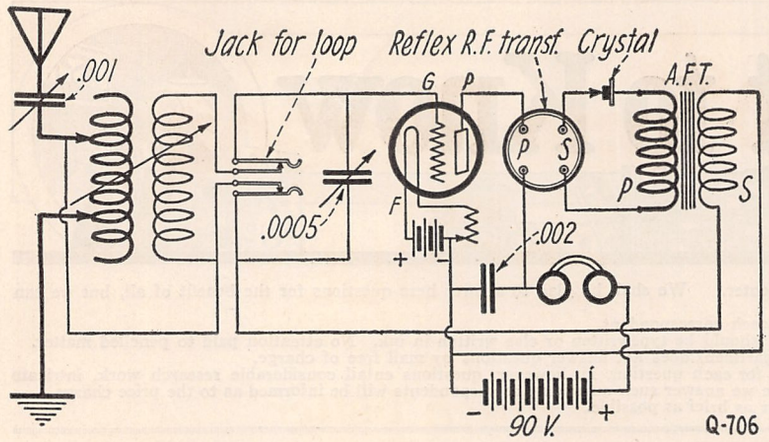
Q. 1. Will you please publish the hook-up of the Erla Duo-Reflex Circuit?

A. 1. The diagram will be found on these pages. A special radio-frequency transformer, manufactured by the Electrical Research Laboratories, is used in this circuit.

Q. 2. During the last year, I have had five WD-11 tubes burned out in my Aeriola, Sr. Is this the fault of the set or tubes?



Here is the So-Called "Phantom" Circuit. Upon Examination It Will Be Seen That It Is a Single Circuit, Tuned Plate Receiver.



Remarkable Results Are Claimed for the "Erla Duo-Reflex" Circuit, Shown Here. Only One Tube is Used for Two Stages of Amplification.

A. 2. We do not believe that the set is at fault in this instance. It is possible that the tubes may be defective, but most likely you have been burning the filaments too brightly, thus decreasing their lives.

CONDENSERS WITH H. C. COILS

(707) Mr. Louis Ruhlandes, Lawrenceburg, Tenn., writes:

Q. 1. What capacity variable condensers are most suitable for the primary and secondary circuits when using honeycomb coils?

A. 1. A condenser of .001 mfd. should be used in the primary circuit, and a condenser of .0005 mfd. will be suitable for the secondary.

Q. 2. What size loop aerial is best for all-around receiving if I use two stages of R. F. amplification?

A. 2. The best loop antenna should consist of eight turns of wire, wound on a four-foot square frame. This is rather large for the average experimenter, and we would suggest a loop three feet square, wound with 10 turns. The last four turns should be tapped.

Q. 3. What particular advantage is there in using bank-wound coils?

A. 3. A bank-wound coil takes up much less room, has a lower distributed capacity than a layer wound one and has an inductance, for a three-layer bank-wound coil, nearly nine times as great as a single-layer coil of the same length.

10 WATT TRANSMITTER

(708) Mr. A. L. George, Atlanta, Ga., requests:

Q. 1. Please publish a hook-up of a 10-watt C. W. transmitter, using rectified A. C. on the plates and using a separate filament transformer.

A. 1. This hook-up will be found in these columns. An electrolytic rectifier is used to supply D. C. for the plates of the tubes.

TWO-STAGE AMPLIFIER

(709) Mr. Carlton Welds, Valley City, N. D., asks:

Q. 1. Please publish a diagram of a single-circuit tuner, using the Atwater-Kent two-stage amplifier.

A. 1. This diagram will be found in these columns.

UV-201A AS DETECTOR

(710 Mr. R. J. Wallace, Harmony, Minn., wants to know:

Q. 1. Will the new UV-201A tube work as well as a detector as the UV-200?

A. 1. Although this tube was not designed as a detector, it will give excellent results in this capacity. Reports indicate that it functions as well as the UV-200 when used as a detector.

Q. 2. Will a set using a WD-11 as a detector, and two UV-201A tubes as amplifiers, give good results?

A. 2. If properly constructed, this combination will work well, but we would advise you to use a separate dry cell for the filament of the WD-11 tube.

Q. 3. Can eight dry cells, connected in series-multiple so as to give six volts, be used with efficiency as an "A" battery for the UV-201A tubes?

A. 3. Dry cells may be used for lighting the filaments of the tubes in this way, if desired, but the dry cells would not last very long. We would suggest a storage battery for this purpose.

FILAMENT RHEOSTAT

(711) Mr. A. D. Cottingham, Denver, Colo., wants to know:

Q. 1. Should the filament rheostat be placed in the negative or positive lead of the storage battery on amplifying tubes?

A. 1. Better results will be obtained if the rheostat is placed in the negative lead of the "A" battery. This is particularly true of the UV-201A tubes. The secondary of the transformers should be connected directly to the negative of the "A" battery.

Q. 2. What is the advantage of connecting the secondary of the transformers to the positive of the "A" battery, as compared with connecting to the negative?

A. 2. The grid of any tube should have a negative potential impressed upon it, consequently one side of the transformer must be connected to the negative side of the "A" battery. As a grid condenser is inserted in the grid lead of the detector, best results are obtained by connecting to the positive of the "A" battery in this case. When this is done, a positive charge is impressed upon the battery side of the condenser. The grid side of the condenser will thus be negative, thereby impressing the correct negative potential upon the grid.

CURRENT CONTROL

(712) Mr. John Dearing, Havana, Cuba, asks:

Q. 1. I have read that when resistance is included in an electric current, instead of checking the current, it consumes it. Where a wire rheostat is used, is the current from a battery kept back by the resistance wire on said rheostat, or is it merely consumed, so that, by the time it has passed through the resistance element there is only a small portion left?

A. 1. The flow of current in a circuit is determined by the resistance in that circuit. A certain resistance will allow a certain current to pass. It does not matter whether the resistance is composed of wire or carbon. When a wire rheostat is used, the current is controlled by the length of resistance wire in series. When a carbon rheostat is used, the pressure applied to the carbon determines the current consumption.

Q. 2. Would a carbon disc rheostat aid in prolonging the life of a charge?

A. 2. As explained above, a rheostat consisting of carbon consumes as much current as a wire rheostat of the same resistance.

H. C. COILS

(713) Mr. John Waples, Ocean View, Va., asks:

Q. 1. How many feet of wire have the D.L.-1250 and the D.L.-1500 coils?

A. 1. The D.L.-1250 has, approximately, 800' and the D.L.-1500, 950'.

Q. 2. Please publish a hook-up of the Erla Duo-Reflex single-tube circuit.

A. 2. This will be found under Question 706.

Q. 3. Could a variocoupler be substituted for two honeycomb coils of 50 and 60 turns, respectively?

A. 3. A variocoupler with the same number of turns on both primary and secondary may be successfully used, instead of the honeycomb coils, as a tuner.

DATA ON THE UV-199

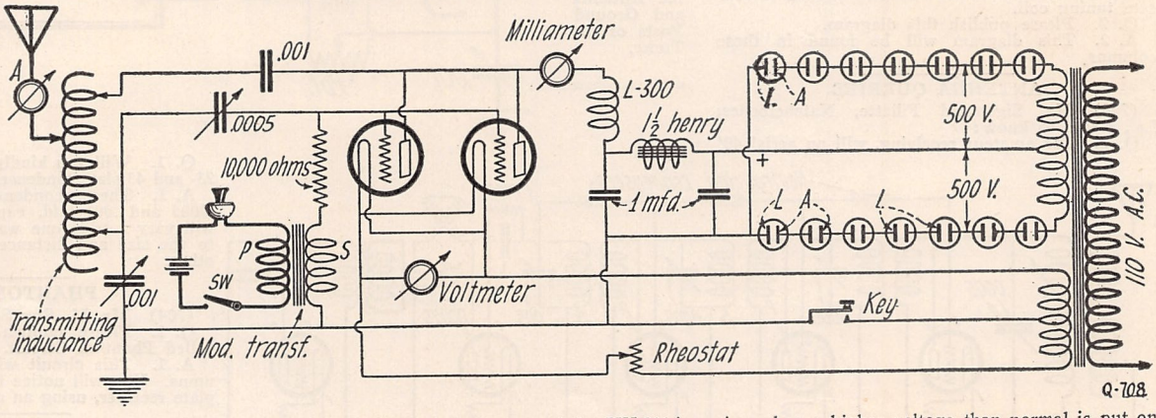
(714) Mr. Geo. Davis, Chicago, Ill., desires to know:

Q. 1. Why does the UV-199 tube fail to function when a higher voltage than normal is put on the filament?

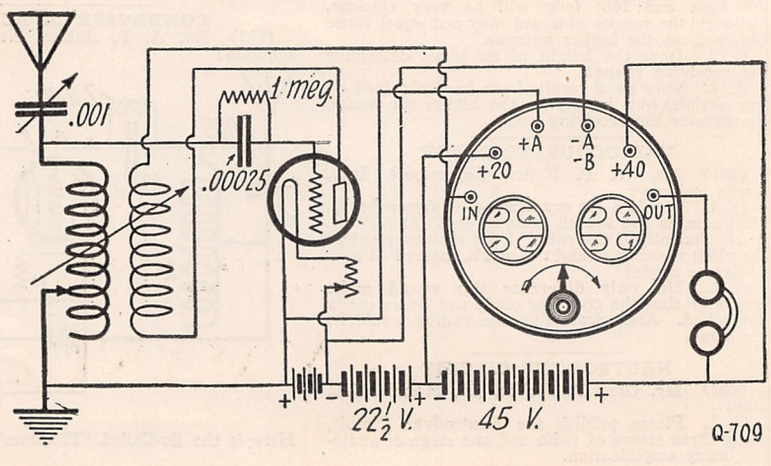
A. 1. The filament of the UV-199 is composed of tungsten, containing a certain amount of thorium oxide. When three volts are applied to the filament, a portion of this oxide comes to the surface and forms a thin coating on the outside of the filament. There is also a continuous reserve just under the surface of the filament. It is this thorium oxide which emits electrons. If a voltage of 5 to 10 volts is accidentally applied to the filament, all of the thorium is vaporized. If the high voltage is left on too long, the reserve is also consumed. When this happens the "B" battery must be disconnected, and the filament lighted to its normal temperature, until a new supply of thorium has come to the surface again. The tube will then function as well as before.

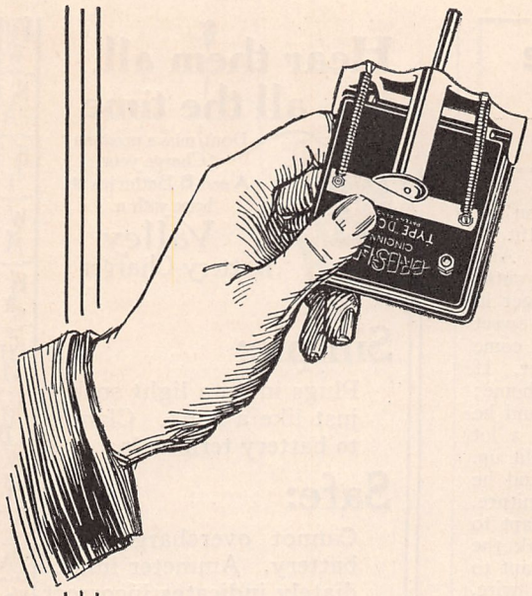
(Continued on page 105)

This 10-Watt C.W. and Phone Transmitter Uses A.C. Rectified by an Electrolytic Rectifier. The Well-Known Colpitt's Circuit Is Used and Very Good Results Will Be Obtained with the Hook-Up.



This Shows How the Atwater-Kent Two-Stage Amplifying Unit is Connected to a Single-Circuit Receiver.



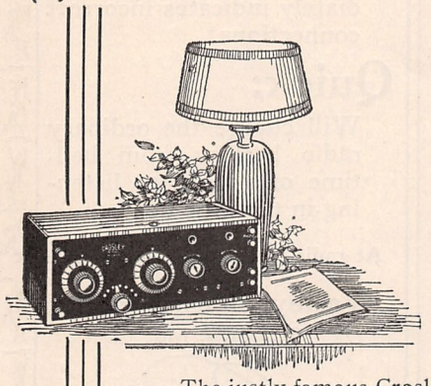


Just one Reason why CROSLEY RADIO RECEIVERS are *so much better*

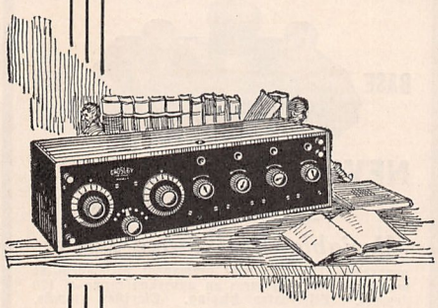
The heart of any receiver is the variable condenser. The superiority of the Crosley book-type variable condenser over the old type interlocking plate air condenser is now generally admitted for the following reasons:

1. Rugged construction that prevents damage.
2. Freedom from short circuits.
3. Permanent metallic contact with plates eliminates sliding contacts.
4. Minimum stray electrostatic field eliminates body effects when tuning.
5. Liberal leakage paths through condenser.
6. Grounded frame provides electrostatic shield.
7. Minimum high frequency resistance or energy loss.
8. Maximum variation in wave length with fixed coil.
9. Maximum mechanical and electrical efficiency.
10. Minimum cost.

We state positively that the substitution of a Crosley condenser for any other type of commercial receiving condenser in any receiving set or circuit will greatly increase the range, volume and simplicity of tuning.



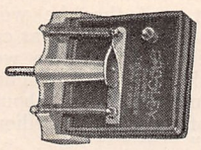
The justly famous Crosley Model VI, a two tube set incorporating one stage of tuned radio frequency amplification and detector. Price—$28.00.



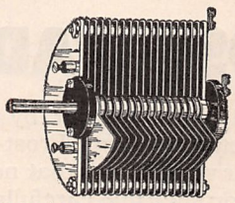
The standard Model X that has made history during the past year, and is now recognized as the most efficient set on the market, will be continued at the same price—$55.00, notwithstanding the advanced cost of materials.

We announce a new Model X, to be designated as Model X-J, equipped with head phone jacks for detector and one stage of amplification, in addition to loud speaker binding posts.

The instrument has been redesigned internally with new molded sockets, condensers having molded plates, rheostats in molded shells, new dials, price —$65.00.



New Crosley type D Condenser has molded plates. Price—$2.25.



Old-fashioned multiple plate condenser which has been largely replaced by Crosley type D.

New York Office, C. B. Cooper, 1803 Tribune Bldg., 154 Nassau St.
Boston Office, B. H. Smith, 929 Blue Hill Ave., Dorchester
Chicago Office, 1311 Steger Bldg., 28 E. Jackson Blvd., R. A. Stemm, Mgr.

Crosley receivers incorporating tuned radio frequency amplification reduce static and other interference to a wonderful degree, which greatly increases summer receiving range.

CROSLEY MANUFACTURING CO.

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3000 ohm set $6.00

"Almost human" in their tone quality

ASK any owner of a pair of Frost-Fones why he prefers them to even the most costly head fones. He will tell you Frost-Fones have an "almost human" tone quality. They also are extremely comfortable; they fit the head without tiring the listener even after hours of use. In addition to these big advantages of clearness and comfort, Frost-Fones are as finely made as a high grade watch. Quantity production, allied with precision methods, has made them greater value for your money than any other headset, no matter what price you pay.

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The quality-standard set by Frost-Fones is reflected in all Frost-Radio. Your dealer will tell you that no other line gives you such fine, carefully-made apparatus at prices which are so reasonable. Go to your dealer today. Ask him to show you Frost-Radio. The line includes Frost-Fones, Plugs, Jacks, Jac-Boxes, Extension Cords, Receiving Transformers, Tuning Coils and Microphones. Every item is a Frost-Radio Product of exceptional quality and value.

HERBERT H. FROST, Inc.
154 WEST LAKE STREET, CHICAGO, ILLINOIS.

Casey's High-Voltage Cat

(Continued from page 37)

the second part must string an aerial on the roof and have a radio receiving outfit at all times in good operating condition.' And I'll tell you why! Because a radio outfit keeps a man at home; he loves to linger in his own little home and listen to sweet music and words of wisdom as they come through the air or, as some say, ether. If a man has a radio outfit he stays at home; if he has none he goes out at night, and he is liable to go somewhere and drink a lot of bootleg hooch and come home all lit up. Then his wife is apt to scold him, and he is apt to get mad and break the furniture, and in breaking the furniture he is apt to knock down the chandelier, and break the windows, and scar the walls. He is apt to throw a chair and break an electric wire, and the wire is apt to set the house afire, and the whole place is apt to burn down to the ground. Or, if you or the janitor rush up to head him off he is apt to go mad and shoot you both, or kill you in some other way, and then the building would get a bad reputation and your widow would not be able to rent it or sell it, and she would be apt to starve to death."

"Strikes me you're mighty apt at apting," he said.

"So every landlord should insist that every tenant have a radio set," I said, paying no attention to his remark. "An up-to-date landlord would tell his janitor to help his tenants string their aerials. As a matter of fact those wires do no harm. Did I ever tell you about Casey's High-voltage Cat?"

I knew I had not, because this was the first talk I had had with my landlord, but it seemed to me desirable to work away from the subject of aerial wires gradually, but to first establish a state of easy friendship and confidence between my landlord and me, so that before the evening was over he would be calling me "Bill", and I would be calling him "Jim," and I've noticed that the best way to become friendly and sociable is to tell a man a story. The right way is to laugh merrily and say "Speaking of cheese ——" if you have a cheese story to tell, or "By the way, speaking of boned codfish——" if you have a fish story to tell. Then you can go ahead and tell the story. So I began: "By the way, speaking of wires on roofs——"

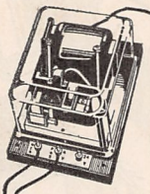
I had this all planned, you understand. I would tell the story, and then I would ask my landlord if he would not like to listen in and hear some good radio broadcast, and then he would become a radio fan himself and be as crazy over it as everyone else is, and he would slap me on the back and say: "That's all right, Bill! Don't you worry about those wires on the roof; put up a million wires if you want to!"

"By the way, speaking of wires on the roof," I began, "this thing about Casey's High-voltage Cat is concerned with wires on the roof. My brother Peter lives in Chicago, in a flat there, and he has been a radio amateur for years. His landlord lived in the same building but he was not like you. He was not a sensible, reasonable man; he was a bull-headed old grouch."

I looked at my landlord to see how he took this, but he did not seem to take it one way or the other. He sat heavy and smoked his cigar.

"That's the kind of landlord my brother had," I continued. "He was an unprogressive, bull-headed old grouch, and he would not allow any aerials on his roof, as all clean-cut, up-to-date landlords do. His

Hear them all, all the time



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Simple:
Plugs in on a light socket just like a lamp. Clamps to battery terminals.

Safe:
Cannot overcharge your battery. Ammeter immediately indicates incorrect connections.

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Will charge the ordinary radio battery from bed-time one night to listening-in time the next.

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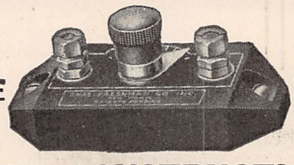
WOI WMC WDAP KDYX PWX



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Variable Resistance Leaks
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A NEW LEAK FOR
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Mounted on any panel in a few seconds—2 mounting screws serving as connections behind the panel.
Complete with either .00025 or .0005 mfd. Micon Condenser

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A necessary essential for every tube receiving set.
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At Your Summer Home on Stormy Days?

Our latest RADIO frequency REGENERATIVE receiver eliminates summer troubles common to other sets. On fair days too, as well as on stormy ones, this set will bring you

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The IDEAL SET for your SUMMER HOME or to take with you ON YOUR CAMPING TRIP.

RADIO FREQUENCY gives it GREAT RANGE and SELECTIVITY, while REGENERATION maintains an UNEQUALLED EFFICIENCY

When winter comes again it is the IDEAL set FOR YOUR HOME.

The BEAUTIFUL WALNUT CABINET harmonizes with refined furnishings in any room in your home.

Model C23 RADAK COMBINES EVERY MODERN IMPROVEMENT, yet it so SIMPLE ANYONE CAN OPERATE IT and get REMARKABLE RESULTS.

No LARGE ANTENNA NEEDED. It is so sensitive that an inconspicuous wire either indoor or out will bring clear reception from many distant stations.

A NEW CIRCUIT using neither grid leaks nor biasing potentiometer, combining radio frequency with regeneration, keeps RADAK in the lead as usual.

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2 stages audio frequency combined with regenerative detector tube.

Vernier tuning controls.

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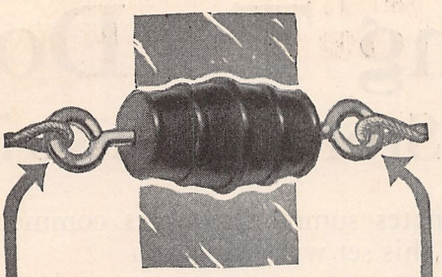

RADION Stops leaks *between* here and here

How much of the current picked up by your antenna gets to your radio set? How much passes right through your insulators and is lost in the ground?

Ordinary insulations may be all right for ordinary electrical currents but they permit leaks of radio frequency currents. Wasteful leaks, leaks which cut down on volume of the received signal. Insist on RADION and notice the difference. It costs no more than substitutes.

Write for descriptive folder today.

18 STOCK SIZE PANELS

Radion, being an insulation material especially made for every wireless use, has the lowest phase angle difference, lowest di-electric constant, highest resistivity and supreme moisture repelling properties. Try it and notice the difference.

Panels, Dials, Knobs, Antenna Insulators Phone Caps, V.T. Sockets. etc. are made from

RADION

"The Supreme Insulation"

American Hard Rubber Co., 11 Mercer St. New York

name was Casey, and he had a wife who was a terror—she thought no more of picking little Casey up, when she was mad at him, and throwing him the full length of a room than she did of breathing. More than once Casey said she thought more of his cat than she did of him, and that was probably true, but Casey also thought more of his cat than he did of his wife. It was a black cat, a big black cat, and both of them loved it. And it was what might be called an extra-electric cat. Its fur was unusually full of sparks.

"Well, this cross-grained old Casey would not allow my brother Peter to string his aerial on the roof, so my brother Peter did what he had to do—he used the wire clothesline that was already on the roof. He equipped it with insulators at each end, and he ran a wire down the side of the building to his flat, and he used the wire clothesline for transmitting. Transmitting is different from receiving. You might say that a mild little receiving outfit like mine is like warm milk, but my brother's transmitting outfit was like sudden-death bootleg hooch—it had a kick.

"My brother Peter was a floorwalker in a department store, so he used his high power transmitting current at night only, when no one—as far as he knew—ever used the washline on the roof. But that was where he was mistaken: the janitor was an old negro, and the old negro's wife took in washing, and she usually used the washline at night. She would go up there with a basket of wet wash and hang it on the washline at night, and take it in in the morning, but she never got a shock because she always wore a pair of old tennis shoes she had picked up somewhere, and the rubber soles insulated her.

"So that was all right until the old tennis shoes wore out and she began going up to the roof barefooted. Then something happened.

"This cat of Casey's was called Moses, and Moses was mighty fond of Sally—that was the old negro woman's name. That cat used to follow her around everywhere, and she was fond of Moses, but a little scary of him because he was a black cat—black as night. She was superstitious about black cats. When he rubbed up against her in the dark his fur would give off little sparks, and that was uncanny and gave Sally the shivers, but she never thought anything about it until she was going up the roof stairs one night with a basket of clothes and Moses was going up in front of her and she stepped on his tail. Then that cat jumped to the top of the stairs and turned around and spat at her and yowled and cussed at her, as if it were putting a black cat's blackest curse on her. So Sally rested her clothesbasket on a step and talked to the cat, and begged its pardon, and begged it not to do her any harm, but to forgive her and consider it all an accident.

"The cat seemed to consider this and think it over, and when Sally picked up her clothesbasket and climbed to the roof that cat hunched up its back and rubbed against her legs and purred, and let on that it was good friends again and that all tail-stepping was forgotten and forgiven.

"The roof was a tin roof, and there had been rain that afternoon, and where the tin was tramped down there were small pools of water. The cat leaped over these, because a cat does not like wet paws, but Sally tramped right across them, and she was standing in one when she took the first garment from her basket and prepared to hang it on the line. And just then my brother Peter turned on his power. And at the same moment Moses, the cat, came and rubbed against Sally's legs. The moment Moses touched Sally's legs Sally touched the wire, and the jolts of electricity that went through Sally, Moses and through that

Warren Radio Loop, Cut Away to Show Construction.

Make Your Set Portable for

WARREN RADIO LOOP

CAMPING AND VACATION

CONTINUE to enjoy the radio programs on your camping trip or wherever you spend your vacation. A Warren Radio Loop allows you to take your set anywhere. Sizes as small as 6 inches square, that can be fitted inside your cabinet.

Send a postal for our Bulletin T-102, containing hookups.

A Type For Every Set At The Best Dealers

Type A-737 (300-700 meters) 6 inches square—non-directional	$10.00
Type A-7236 (175-1000 meters) 6 inches square—non-directional	12.00
Type B-2537 (300-700 meters) 18 inches square—directional	20.00
Type BL-2520 (200-18,000 meters) with honeycomb coil, 18 inches square—directional	25.00

Write for Bulletin T-102

V-DE-CO RADIO MFG. CO.

ASBURY PARK, N. J.
Dept. N

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RADIO PHONOGRAPH ATTACHMENT

Hard Rubber Panels
3/16x7x12 $1.25 Ea.
3/16x7x18 $1:50 Ea.

Dials
3 inch—50c Ea.
4 inch—60c Ea.

Unscrew Headphone Cap and replace with Huguenot
Fits all Standard Headphones and Phonograph Tone Arms. For Special Make Phonographs use Bushing 50c Extra

No Metal Parts to Bend
No Leaks or Loose Connections
Quickly and Easily Attached
Made of Black Polished Hard Rubber

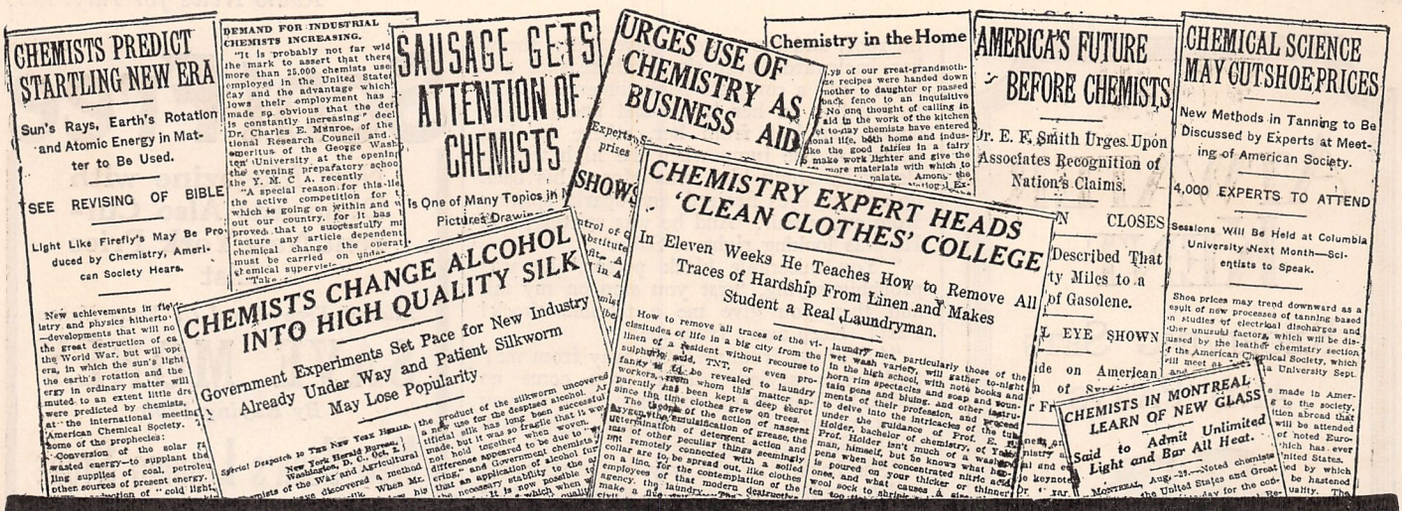
Double Phone Attachment.....$3.00
Single Phone Attachment.....$1.00

Mail orders filled promptly on receipt of remittance.
Specify make of phonograph and headphones.

McKENZIE ENGINEERING COMPANY
NEW ROCHELLE, N. Y.

Dealers—Order from Your Usual Jobber.
Special discounts to the trade.

AMPLIFY WITH YOUR PHONOGRAPH



The United States Needs Chemists

What did America get out of the War? You often hear that question asked, yet few people realize just what material advantage the United States did gain. She gained industrial supremacy. Hundreds of manufactures formerly almost unknown here, have come to this country to stay. With hardly an exception they belong to the so-called Chemical Industries, for which the services of trained chemists are essential. The dyestuff industry alone gives employment to thousands of chemists, for whom there was little demand prior to 1914. Outside of the laboratory there are innumerable executive positions which can be filled only by men who understand chemistry.

The salaries of chemists are good, and the work is fascinating. Opportunities are plentiful for independent work in agriculture, medicine, food purification, water supply, the development of patents, and countless other fields.

Now is the time to get into this fruitful profession while it is yet uncrowded.

Learn Chemistry at Home

Dr. T. O'Conor Sloane, the eminent scientist, will teach you Chemistry in your own home. You do not need to give up your present employment; the lessons may be studied in your spare time. Dr. Sloane has written the course in a simple yet comprehensive way. His many years of teaching and practical experience are placed at your disposal. The lessons and experimental work are so entertaining that it becomes a pleasure to study. No previous schooling is required. The course gives you as thorough training in general chemistry as you would have obtained in college. It is indorsed by leading scientists and educators, and is considered the most unique course of its kind ever presented.

Easy Monthly Payments

You can pay in small monthly amounts as you go along. The price of our course is very reasonable, and includes everything necessary for its completion. There are no textbooks to buy extra, and the chemicals and apparatus used for experiments are supplied without additional charge to the student. Our plan places an education in chemistry within the reach of everyone.

EXPERIMENTAL EQUIPMENT

Given to Every Student Without Additional Charge

The experimental outfit illustrated here is furnished to every student. It comprises 42 pieces of apparatus and 18 chemicals, all enclosed in a hinged box which is itself a useful laboratory accessory.

Dr. T. O'Conor Sloane Will Teach You

T. O'CONOR SLOANE
A. B., A. M., Ph. D., LL. D.

Noted instructor, lecturer and author. Formerly Treasurer of the American Chemical Society, and a practical chemist of vast experience, with many valuable achievements to his credit. Dr. Sloane has taught and practiced Chemistry for a great many years. He is now Educational Director of the Chemical Institute of New York. All of our students receive his personal instruction and supervision of their training.

Special 30-Day Offer

For a short period we are making a special offer, which it will be worth your while to take advantage of. Write for our free book, using the coupon below or simply a postal card. This will not obligate you in the least. Do not wait until tomorrow. Send the coupon now while you think of it, and let us tell you our story.

The Value of Chemistry

Did you know that aluminum formerly cost over $100 a pound? In 1886 an American chemist, C. M. Hall, discovered a cheap method for extracting it from its ores, which brought the price down to 25 cents a pound!

Did you know that carborundum, the universal abrasive was unknown until E. A. Acheson, another American chemist, discovered it in 1891?

Did you know that silicon, an important ingredient of special steels, fell from $100 an ounce to 10 cents a pound, due to a cheap method of production evolved by American chemists?

Did you know that the dye, indigo, dropped from $4.00 a pound to 15 cents a pound when the chemists learned how to prepare it in the laboratory?

Did you know that between 1914 and 1917 the American dye exports jumped from 2 million to 57 million pounds?

Did you know that vanillin, the flavoring principle of vanilla, was reduced in price from $800 a pound to $10 a pound when chemists perfected a method for its synthesis?

Did you know that John Hyatt, an American chemist, invented the useful commodity, celluloid?

Did you know that Thorium Nitrate, used in gas-mantles, sold for $200 a pound in 1895? In 1916 it was priced at $2.60 a pound, due to improved chemical methods of refinement.

These are only a few of countless instances where Chemistry has revolutionized industry. The same chance awaits you if you will master the science.

Chemical Institute of New York, Inc.
Home Extension Division 7 **66-R-WEST BROADWAY, NEW YORK CITY**

CHEMICAL INSTITUTE OF NEW YORK
Home Extension Division 7
66-R—West Broadway, New York City.

Please send me at once without any obligation on my part, your free Book, "Opportunities for Chemists," and full particulars about the Experimental Equipment given to every student. Also tell me about your plan of payment and special 30-day offer.

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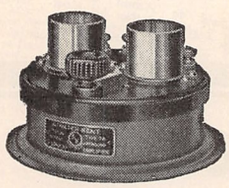
ATWATER KENT

RECEIVING SETS AND PARTS



2-stage Amplifier

IF you are now working with a one-tube set, the 2-stage amplifier shown here will give you the necessary volume of sound to make a loud speaker possible.

It is a compact unit—transformers are sealed in the base so that no dampness can affect the working quality of the instrument.

To demonstrate the damp-proof qualities, one of these instruments was soaked in a tub of water for several hours, then put into a circuit and tested for reception with perfect results.

Send for an illustrated folder showing all parts and complete sets.

ATWATER KENT MFG. CO.
4943 Stenton Ave., Philadelphia

tin roof, and the scare it gave Sally, threw her backwards over the clothesbasket and turned her a complete back somersault, and landed her on her hands and knees. And about ten feet from her, where he had landed in one jump when the high tension electricity stung him, was Moses, his back up and his eyes fire-red, and sparks spitting from every hair. And he was spitting, too. He was looking right at Sally.

"'You miserable black person,' he was probably saying, 'first you step on my tail and then you give me a terrible shock! Pzzt! Keep away from me!'

"'Git 'way from me! Git 'way from me!' Sally was saying. 'Do'n' you come no nearer! You stang me once, but if you sting me ag'n I'll rasp the hide right offen you! Git 'way from me!'

"She backed all the way to the stairway, and backed down the stairs, talking to herself and to the cat, and the cat came after her, spitting and complaining.

"When Sally came to Landlord Casey's door she knocked, and then dodged inside and shut the door. As soon as the door was shut the cat began scratching on it, crying to be let in.

"'Do'n' you open that do'!' Sally warned. 'Do'n' you let that Moses cat in! That Moses cat is a cat ob de debbil an' he just chock full ob elercktricity. He touch me and—wham!—he knock me head ober heels. That cat's wuss 'en a third-rail, he am! I ain't know any sich high-powerful elercktric cat in de world; no suh! An' I come here to give fair warnin' that if that cat am allowed to projasucate around these here premises at liberty, like he been, me and my old man gwine leave! Yassah! We don' wuk in no house where no high-power elercktric cat projasucates around. No sah!'

"So Casey opened the door and let the cat in. He bent down and patted the cat.

"'Tis nonsinse!' he declared. 'Th' cat is no more electric than anny other cat. I feel no sparkin' from it at all.'

"At that Sally backed for the door, her eyes as big as saucers, for she had no use for a man who could touch that cat and not get a shock. But, even so, all might have been well if Mrs. Casey had not come out of her bedroom just then. She had covered her face with some sort of blue clay she had bought a jar of, for her complexion, and the way she looked was enough to frighten anyone. She bent down and picked up Moses, and as far as Sally could see she did not get a single shock. So out of the door Sally went with one shriek, satisfied that Casey and his wife were the devil and his wife, or at least a couple of witches, with their black cat.

"Sally and her husband got out of that house that night and never did go back. They had had enough of Casey's High-voltage Cat. And, you see, sir, all that trouble would have been avoided if that landlord had allowed my brother Peter to string a proper aerial on the roof."

"Well, I don't know but there's something in that," said my landlord.

"There's a great deal in it, I can tell you!" I declared. "The up-to-date landlord recognizes up-to-date matters, and provides for them in up-to-date ways. And if you don't know what radio really is you can't understand what it means to one and all. Have you ever listened in to good broadcasting?"

"No, sir," he said, and I was pleased to notice that his tone was quite other than when he had entered my apartment.

"Then just let me tune in and show you what it is like," I said, and I added: "Oh, we'll have you a regular radio fan in no time, I'll warrant! See how simple it is—I turn this knob, and then this one, and move this one until—ah!"

Out from my loud speaker came the well-loved voice of the announcer of WPX:

Sent Free

New Magazine with Diagrams Also Current New York Price List

Mailed Free—Send Us Your Name

SAVE MONEY

By Buying From

NEW YORK'S LEADING STORE

SPECIALS

Complete parts for a Cockaday 4 circuit tuner Radio Set...$ 8.95

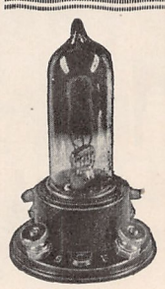
$5.00 Variometers	$1.95
5.00 Variocouplers	1.95
3.25 23 Plate Condensers.	.75
3.75 43 Plate Condensers.	.95
.75 3 inch dials	.25
.75 Rheostats	.35

At the time this magazine went to press, we received a large shipment of vacuum tubes. The following are on sale:

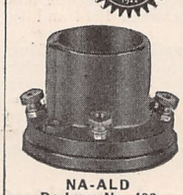
WD-11 1½ volt tubes	$ 6.50
WD-12 1½ volt tubes	6.50
UV 201A 6 volt tubes	6.50
216A 6 volt tubes	10.75
VT2 6 volt tubes	8.95
UV199 3 volt tubes	6.50

Send money order, certified check or cash.

Liberty Radio
106 Liberty St. N. Y. C.



NA-ALD Special Socket No. 499



NA-ALD De Luxe No. 400

It's the contact that counts

The dual-wipe contact strips of the Na-ald De Luxe socket avoid the troubles experienced with the socket of conventional design. Because of thorough cure and high dielectric properties this socket keeps plate to grid losses at a minimum (of particular importance in Flewelling Circuit or in Radio Frequency).

Price 75c

The Na-ald Special Socket No. 499 is a sturdy little socket for the G. E. No. 199 dry-cell tube. It has special slot construction, and is moulded of genuine Bakelite. The heat from soldering connections will not affect these sockets.

Price 50c

Booklet with wiring design and instructions for Hazeltine's Neutrodyne circuit, together with other selected circuits, packed with each Na-ald product or sent in exchange for cover taken from any Na-ald carton.

Alden Manufacturing Co.
Dept. K 52 Willow Street
Springfield, Mass.

RADIO PRODUCTS NA-ALD

$1000.00 in prizes

for the best results with radio frequency. Read how you can enter this Summer's contest.

FOR the fifty best articles setting forth how radio frequency has helped conquer summer static and other forms of interference (such as from spark transmitting stations and your neighbor's radiating recieving set) the Acme Apparatus Company will pay a total of one thousand dollars in cash and radio apparatus.

Each article submitted must narrate the personal experiences and experiments of the writer in securing distant stations, in avoiding interference and distortion, and in securing volume and clearness of reception. Wiring diagrams showing the hook-ups used to secure these results will add greatly to the value of the article. No article shall exceed five hundred words.

Radio and audio frequency transformers of any make or brand will be eligible. The contest starts June first and ends September thirtieth. In case of a tie, each tieing contestant will receive the full amount of the prize. All articles must bear a postmark of not later than October first. Do not stay out of the contest for fear that you are not an "expert." A novice with natural mechanical or electrical ability may hit on a combination which will win the first prize —$250.00 in cash. Send the coupon or apply to any radio dealer to secure the four page folder explaining complete details of contest, the judges, the prizes to be given, etc.

ACME

for amplification

ACME APPARATUS COMPANY
Cambridge, Mass.

Gentlemen:—Please send me full details of radio frequency contest.

Name .....

Street .....

City ..... *State* .....

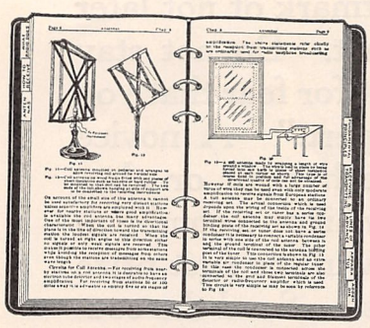
GOOD RECEPTION EASY—

SUMMER OR WINTER!

—If You Own a LEFAX Radio Handbook.

The man who owns a Lefax Radio Handbook gets good results from his set at all seasons of the year. Difficulties disappear readily. He can take instant advantage of every new development to improve his set and perfect reception—because Lefax Radio Handbook keeps pace with the new developments.

The ONE Best Book on Radio



LEFAX

Never Grows Old!

Lefax Radio Handbook is loose-leaf and every month additional pages are sent out covering the new developments. These pages fit the handbook and may be inserted in appropriate places in the handbook thus keeping it *perpetually up-to-date!* Written by the two chiefs of U. S. Bureau of Standards Radio Laboratory (Dr. J. H. Dellinger, and Mr. L. E. Whittemore). Get your copy now. Price $3.50 including one year of the service which keeps it up-to-date.

LEFAX, Incorporated

147 So. Ninth St., Phila., Pa.

"This is WPX, Rahway, New Jersey; AKG announcing. One minute please!"

"We always get something good from Rahway," I said eagerly to my landlord. "Fine music or good talks. And is it not wonderful that all this comes to us through the air? What you are going to hear now hundreds of thousands will hear. In every town and village, in thousands upon thousands of flats and apartments—Hush! he's beginning now!"

"This is WPX, Rahway, New Jersey; AKG announcing," came clearly and distinctly. "The next number on our program this evening will be a talk by Percy G. Bimfister, Secretary of the United Tenants' Lower Rent and Better Service Association," and then another voice, the voice of Percy F. Bimfister, saying: 'Tenants! All landlords are cut-throats and rent-boosters. Tonight I am going to tell you how to correct some of the abuses all tenants suffer from and how to use the laws against the landlords——"

I leaped for the knobs of my radio outfit, but I was too late. My landlord turned purple in the face and in two strides was out of my door. Five minutes later my bell rang and when I opened the door the janitor stood there. He did not say a word but he handed me two long poles around which my aerial wires were wrapped carelessly.

"Hah!" I exclaimed angrily. "So that's it, is it! Then I *will* listen to what Percy F. Bimfister has to say!"

I went back to my radio, but Percy F. Bimfister said nothing to me that night. My aerial was no longer on the roof; it was in my livingroom.

Broadcasting Changes at Chicago

(*Continued from page 35*)

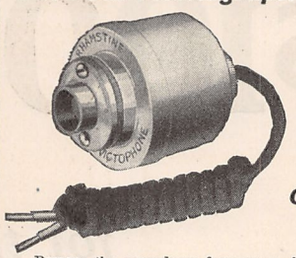
The designation of the new broadcasting station, where a regular program will be given, is the Edgewater Beach Crystal Studio. Interior decorations will be heightened appreciably by the use of red velour drapery with indirect lighting and furnished distinctively in period style.

The operators will be in a triangular glass house from which they will have entire view

RHAMSTINE*

VICTOPHONE

For Your Phonograph or Horn



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Price $7.50

Complete with Cord

Remove the reproducer from your phonograph and put on the **Rhamstine* Victophone;** your needs are met for a perfect loud-speaker.

Compare it with any other loud-speaker designed for the same purpose—in volume, in tone, in quality—it surpasses all—and the price is only $7.50 —backed by the Rhamstine* name.

Dealers write for discounts.

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Supersensitive Broadcasting

RTS TESTED MINERALS

Ever since Galena has been used for radio purposes, **RTS Tested Mounted and Unmounted Galena,** has been noted for its supersensitive quality.

All RTS Crystals are individually tested, and pass THREE INSPECTIONS before being boxed.

RTS Unmounted Broadcasting Galena per box ....$.25
RTS Mounted Tested Galena per box ..... .25
RTS Unmounted Tested Silicon per box ..... .25
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Dealers and Jobbers write for trade proposition.

RADIO TESTING STATION

Dept. R-7 **BINGHAMTON, N. Y.**

Variable Grid Leaks	$ .45 each
Tubular Grid Leaks (all resistance)	.50 each
Tubular Grid Leaks mounting	.35 each
Single V. T. Sockets Type S-10	.90 each
Triple V. T. Sockets Type S-4	2.70 each
Bakelite WD-11 Sockets	.50 each

RADIO SERVICE & MFG. CO.

(Established 1918)

Factory—Lynbrook, L. I.

We carry a Complete Line of Radio Apparatus

Spirola TRADE MARK **LOUD SPEAKER**

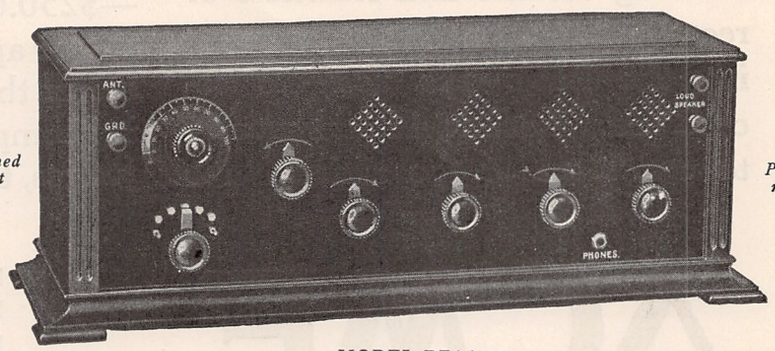
IMPROVED—LARGER

famous tuned Rhamstine unit built-in. True cabinet type, beautiful mahogany finish. Great volume, superb tone. Guaranteed. Postpaid (C. O. D.) **$12.50**

Spirola Mfg. Co., Box 70, Ann Arbor, Mich.

"CLEARTONE"

Designed right



Priced right

MODEL RFAA-60

An ultra-efficient receiver of the highest standard of quality and design, comprising one stage radio frequency amplification, detector and two stages audio-frequency amplification.

Vallejo, California, writes: "Hearing Toronto, Canada (2200 miles), Ottowa, Canada (2400 miles), Calgary, Canada; Denver, Colorado and many others."

San Juan, Porto Rico, advises: "Using only first stage of audio amplification tuned in clearly Denver, Colorado (2350 miles), Minneapolis, Minn., (2200 miles), Fort Worth, Texas, and all stations east of the Mississippi through very heavy static."

Barwick, Ontario, Canada, informs us: "The first night I tuned in, heard KFI, Los Angeles, California, (1600 miles) Dallas, Texas, (1100 miles) and many others."

The above results only substantiate the claim that for distance, clarity and volume, the performance of "CLEARTONE" MODEL RFAA-60 is unsurpassed.

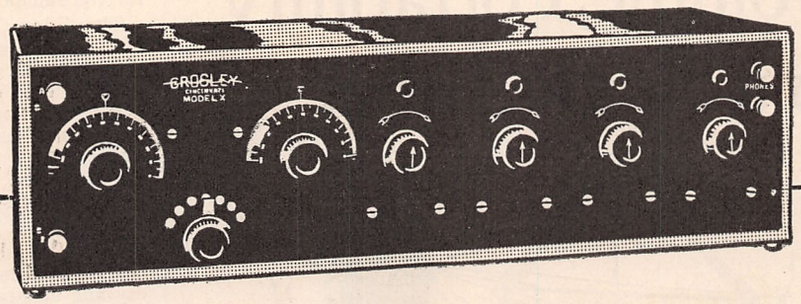
And the Price *only* $60.00

CATALOG FREE ON REQUEST

Jobbers and Dealers:—Certain territory still available.

THE CLEARTONE RADIO COMPANY

McMILLAN and ESSEX PLACE **CINCINNATI, OHIO**



CROSLEY

Uses Formica for Panels and Insulation

CROSLEY radio sets are universally known and used. They are produced in a factory that is famous for its well developed production methods and factory systems.

Radio engineers for the Crosley Manufacturing Company, like those of nearly every other well known independent radio manufacturer, appreciate the superior qualities of Formica insulation for radio.

They use it in panels and for many other purposes in connection with their radio product, because it is good looking, because it works well with ordinary tools and because it has high di-electric strength and maintains it indefinitely, improving with age.

The Crosley Company is a large distributor of Formica panels and of radio parts of its manufacture in which Formica is used for insulation purposes.

THE FORMICA INSULATION COMPANY

4618 Spring Grove Ave.,

CINCINNATI, O.

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414 Finance Bldg... Cleveland, Ohio
9 S. Clinton St. ..... Chicago, Ill.
313 Title Bldg..... Baltimore, Md.
47 King St..... Toronto, Ontario

Formica dealers can supply you promptly with panels in all standard sizes.
They can also supply special sizes when you want them.

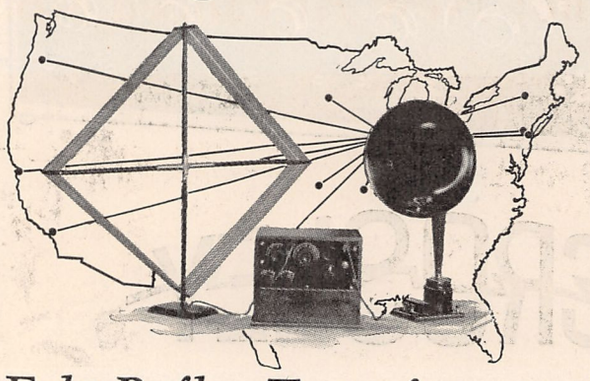
FORMICA

Made from Anhydrous Redmanol Resins

SHEETS TUBES RODS

Range, Volume, Portability With a Single Tube!

Any receiving set is vastly improved by Erla transformers, covering a wave-band of 200 to 800 meters. TypesAB1, 2, 3, $4. Reflex, $5



Erla Reflex Transformers Assure This Result

Vacation time holds new and untold pleasure, when you tune in with Duo-Reflex, the most powerful single-tube circuit ever built.

Through a loud speaker, it brings in all but the most distant stations; and with headphones it ranges from coast to coast. Its light weight, less than fifty pounds, with dry cells, makes it ideal for camping trips or week-end tours.

Interference and static disturbance are conspicuously absent. Even in hottest weather, clear and perfect reception is assured.

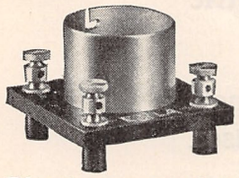
Responsible for the amazing efficiency of this circuit, and the secret of its power, is the Erla radio frequency reflex transformer. Overcoming completely the high capacitance of domestic vacuum tubes, and with lowest inherent capacitance, it provides maximum amplification without distortion.

Everybody can afford Duo-Reflex! Because of simplest construction, it costs considerably less to build than other circuits of comparable range and volume.

Your dealer will gladly present you with a copy of our Bulletin No. 13, giving diagrams and precautionary notes covering its assembly. Or write us direct.

Erla bezels, in 1" and 1½" sizes, are finished in polished nickel or dull black enamel. Telescoping rim fits any ⅛" to ¼" panel. List, 20c

Erla fixed condensers reveal markedly superior accuracy, being exactly calibrated and individually tested. Made in eleven sizes, 35c to $1 each



Erla sockets are unmatched in beauty of finish and excellence of workmanship. All parts triply nickeled. Polished Radion base. List, $1

Dealers and Jobbers: Erla leadership in research and quality manufacturing spell increasing opportunity for Erla dealers. Rapid turnover and liberal discounts yield healthy, substantial profit

Electrical Research Laboratories
Dept. C 2515 Michigan Ave., Chicago

ERLA

of the studio and the musicians in the dining room. Concerts will be given regularly and an extensive program has been mapped out for the summer season.

The Edgewater Beach Hotel figured in the early history of wireless before broadcasting on the present scale was dreamed of, as the site of one of the Governmental stations operating regularly with Arlington station at Washington. It was here where much of the pioneer work was done that afterward led to greater things in the field of middle western wireless.

Radiophone Station WDAP, Chicago Board of Trade, located at the Drake Hotel, has acquired more space and all the machinery and apparatus used with the broadcasting service are now being installed in one large room. Every piece of apparatus will bear a card indicating exactly what its function is. It will be entirely encased in glass so that no noises will go out with the microphone. There will be a runway entirely around the set so that visitors can have access to the operating room and will be able to see for themselves what a modern broadcasting station looks like.

There will be a very novel and extraordinary antenna tower. It will be a single tower running 135' in the air and resembling a gigantic mushroom. Great things are expected from the new antenna arrangements, and the problem of radio engineers during the summer in the way of obtaining radius because of weather conditions may be overcome. Entertainment is secondary at the Board of Trade station because of the agricultural and live stock and economic service disseminated from the station by the Chicago Board of Trade.

Wave-Lengths for Class A Stations Being Assigned

(*Continued from page* 36)

Frequency	All Districts Wave-Lengths	Secific Districts
1110	270	(4-7-8)
1100	273	
1090	275	
1080	278	(1-6-9)
1070	280	
1060	283	
1050	286	(3-8-9)

SIX NEW CLASS A BROADCASTERS LICENSED

Call	Station	Wave-Lengths Meters	Power Watts
KFFZ	Al. G. Barnes Amusement Co., Dalas, Texas.....	226	20
KFGD	Chickasha Radio & Elect. Co., Chickasha, Okla.	248	20
WABA	Lake Forest College, Lake Forest, Ill.	266	100
WABB	Lawrence, Dr. John B., Harrisburg, Pa.	266	10
KFFY	Pincus & Murphy, Inc. Alexandria, La.	275	100
WRAF	Radio Club, Inc., Laporte, Ind.	224	10

The above stations were licensed during the week ended April 20, 1923, by the Department of Commerce, and started transmitting on their respective wave-lengths at once.

New Radio Patents

(*Continued from page* 49)

action in the reception of Hertzian waves. In the arrangement shown, a mercury rectifier is used, the self-inductance of the antenna being employed as an auto transformer. This is combined with the use of the heterodyne, consisting in the induction of an E.M.F.V. and an auxiliary E.M.F.V. in the main circuit and, if a sufficiently large auxiliary E.M.F.V. is used so that the rectifying

PHANTOM - CIRCUIT

Build Your Own. This marvel of mystery, using no loop, no aerial and no ground brings in music instead of interference. We have heard stations 950 miles distant on one tube. By using WD-11 tube set can be entirely self contained. Very easy to build from our instructions, use your own spare parts, nothing complicated like radio frequency or super regenerative. Only one tuning control. Complete instructions, with hookup and photo of circuit mailed to you for 60 cents. Stamps accepted.
Vesco Radio Shop Box RN-704 Vacaville, Calif.

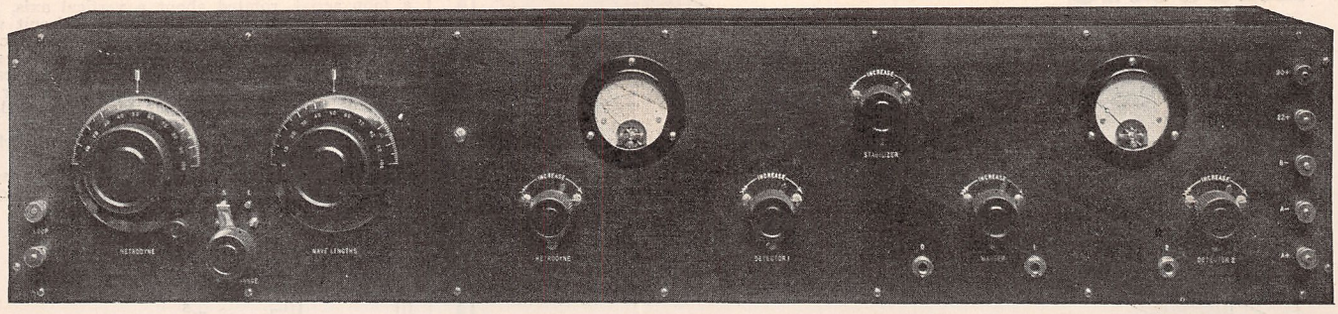
CHARGE YOUR BATTERY
(RADIO OR AUTO)
at HOME for a NICKEL
The HOMCHARGER
POPULARLY PRICED — PAYS FOR ITSELF
SEND FOR FREE BOOK
THE AUTOMATIC ELECTRICAL DEVICES CO.
118 W. THIRD ST. CINCINNATI, OHIO

Chaslyn
SINK OR SWIM
SOS
Hydrometer
Tests your battery instantly by the way the Balls sink or swim in the acid. Outfit, including Hydrometer, Depth Gauge, and Water Filler, Postpaid $1.00 Circular Free.
Chaslyn Co., Dept. I, 4315 Kenmore Ave., CHICAGO

— FREE —
A book on how to get "Better Results from Radio"—Write to Willard Storage Battery Company, 281 East 131st St., Cleveland, Ohio
STORAGE BATTERY
Willard

For Long Distance Concerts

Super-Heterodyne; New Advanced Model "C"



FRONT VIEW
Wave-length Range 160 to 850 Meters, Dimensions 40"x8"x7¾".

Simplicity—Only two variable dials for all waves 160 to 850 meters

Efficiency—Uniform maximum amplification over entire range

Tubes—Uses either UV-201A, 201, 199, WD-11, WD-12, etc.

Design—3 transformer radio amplifiers, 2 audio, 2 detectors, 1 osc.

Selectivity—The only receiver that works through local broadcasters

Range—2000 miles using Radio Corp. loop, more with antenna.

The Super-Heterodyne is the most efficient method of radio frequency amplification known.

The Super-Heterodyne is the only receiver in New York that receives long distance radiophone through local broadcasters.

The Super-Heterodyne is used extensively by commercial radio companies for long distance ship to shore traffic.

May we send you full particulars?

Write for Complete 1924 Catalog A

Experimenters Information Service

DESIGNERS OF THE HIGHEST CLASS RADIO APPARATUS IN THE WORLD

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"American Beauty"

Electric Soldering Iron

The Best Iron Made

For Soldering all connections, parts, etc. Ready for use by attaching to any electric light socket. The cost of operation is insignificant.

Many thousands in use by amateurs, engineers, manufacturers, telephone companies and many others.

For radio, telephone and all light work our latest Model No. 3138 is ideal; also two larger sizes for doing heavier work.

For twenty-eight years our name and trade mark have been a guarantee of quality and dependability.

AMERICAN ELECTRICAL HEATER COMPANY
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Oldest and largest exclusive makers. Established 1894

MEMORIZE CODE IN ONE HOUR

BKUMA YRLSBUG
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Attentive Beginners Who Use

DODGE TWO DOLLAR RADIO SHORT CUT

SMASH ALL RECORDS—WIN LICENSE

Best FOURTEEN Records Reported to date by Licensed Operators who, as Beginners, used our Method AVERAGE TWENTY-EIGHT MINUTES—Many average One Hour.

For ONE DIME will mail Records by many Beginners in all Districts who easily became Licensed Operators, and to help enlighten and encourage others, have told the story of their Quick Success.

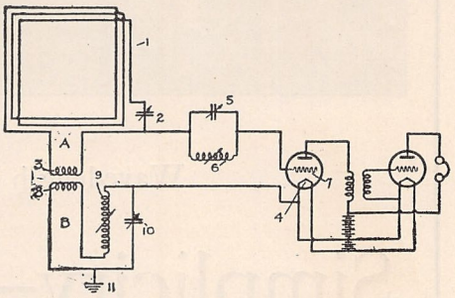
C. K. DODGE Dept. N, Mamaroneck, N.Y.

portion of the current be in proportion with the potential applied to the two detectors, twice as sensitive a receiving circuit may be obtained as in case the usual quantities are used.

UNI-DIRECTIONAL RECEIVING SYSTEM

(Patent No. 1,449,253. Issued to Morris Sperry Strock, of Washington, D. C., March 20, 1923.)

This invention relates to uni-directional receiving systems. In the illustration is shown an arrangement consisting of two radiant energy absorbing means, A and B. At 1 is shown a coil of one or more turns of wire, commonly called a loop aerial, rotated about a vertical axis, and 2 is a variable condenser forming a circuit with said loop aerial, as shown. Means for inductive coupling of radiant energy absorbing means A to radiant energy absorbing means B is indicated by a coil 3. The circuit, including condenser 10, inductor 9 and coil 8, comprising circuit B, is considered as having the effect of an open antenna, impressing a voltage upon grid 7, which is due to the electro-static component of the wave. In operation, the radiant energy absorbing means A and B are tuned to the frequency



of the incoming wave, and the loop aerial is rotated so that its plane is perpendicular to the plane of the incoming wave front. The circuit, consisting of condenser 5 and inductor 6, must be properly adjusted, so that a maximum voltage will be impressed upon the grid 7. An alternating voltage of the frequency of the incoming wave is impressed upon the filament 4; likewise, an alternating voltage of the frequency of the incoming wave is impressed upon the grid 7. By means of the coupling coils 3 and 8, the electrical energy in A may be made to aid or oppose the electrical energy in B. When the loop aerial is in the position previously referred to, and the voltages associated with the two circuits A and B are in phase with each other, the receiving signal will be a maximum intensity. If the loop aerial 1 now be rotated through 180 degrees, the voltage associated with circuit A falls to zero, and then appears again, but in a different sense, i. e., its phase has shifted 180 degrees. On the other hand, the voltage associated with circuit B remains unchanged; hence, when the coil is rotated into the new position, the voltages in the two circuits will be out of phase by 180 degrees, so that they will oppose and cancel each other. Thus, as the loop aerial is rotated about a vertical axis through 360 degrees, a single position will be found where the signal is of maximum intensity.

Radio Tests on Pacific Planned

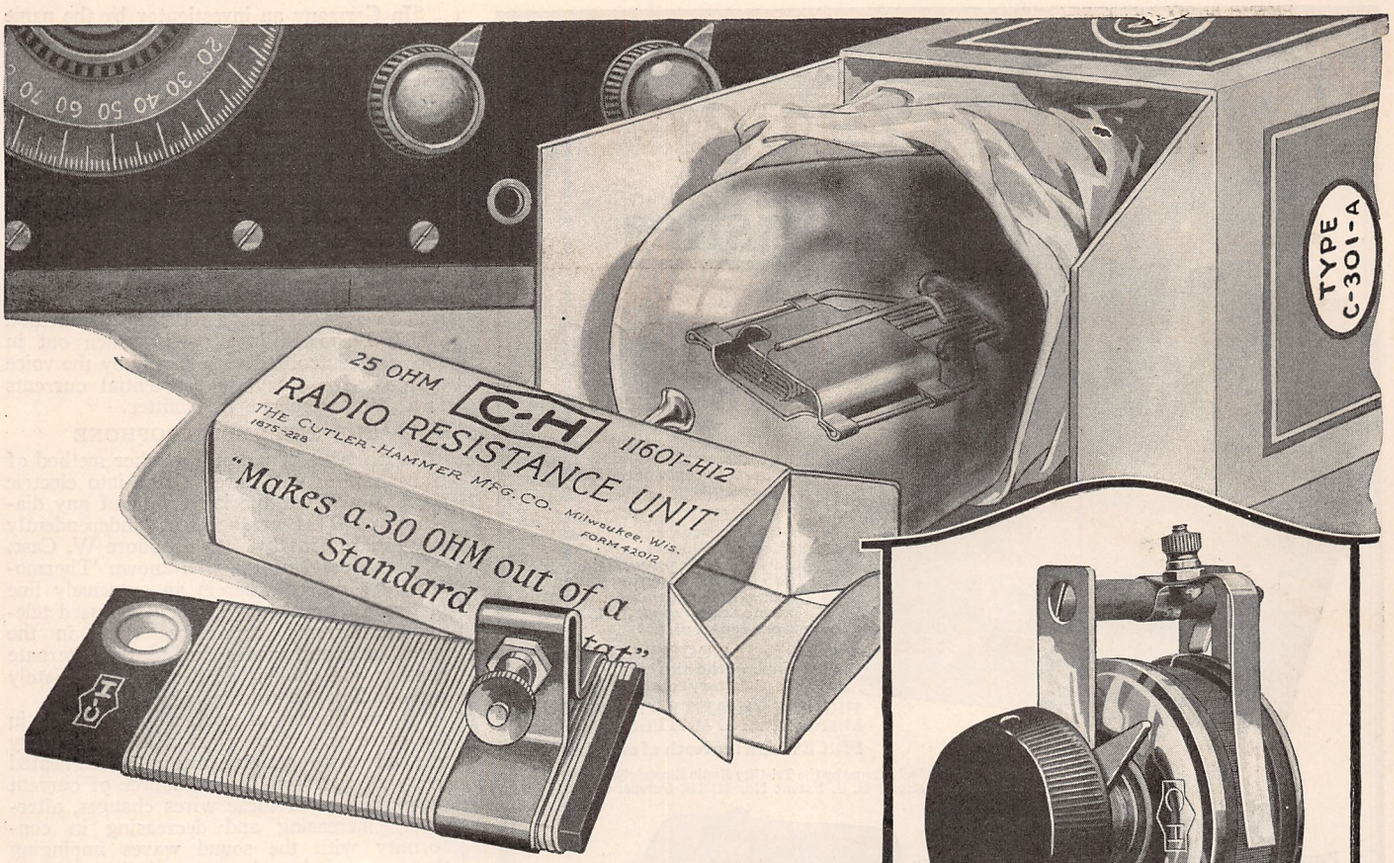
(*Continued from page* 52)

several messages with the Federal Beach Radio Station, San Francisco, at a distance of about 4,700 miles. It is further stated that instances of long distance work of this nature with the 5 K. W. arc sets are a little unusual, but not at all exceptional.

The Flame Microphone

(*Continued from page* 14)

"Here again history repeats itself. After I had first used the gas flame as a detector of wireless signals I next tried the intensely heated gases in an electric arc and found the same phenomena, although very imperfect on account of the overwhelming loud disturbances due to the arc itself. So again it has been found that a long electric arc in the air possesses the property of modulating to some extent the electric current passing between the electrodes in response to the changes of air pressure produced by the impinging sound waves.



Buy This Unit With Your New Tube!

It Saves the Cost of New Rheostats and the Trouble of Redrilling Your Panel

You can put the new "A" Type (C-301-A or UV201-A) receiving tubes in your set and enjoy better results *tonight.* The C-H Radio Resistance Unit adds to your *present* rheostats just the number of ohms required for the regulation of these new ¼-ampere tubes. You do not have to spend several dollars for new rheostats—nor miss a single hour's entertainment while you bother to redrill your panel for them. Just put the eyelet of the C-H Unit over the post of your rheostat, and attach the wire you had to remove to do so to the binding post of the unit. Regulation is obtained from the front of the panel as before—but the unit itself is adjustable to care for changes in battery potential.

Panel Mounting if Desired

The C-H Radio Resistance Unit may be mounted directly on the panel, if desired, attached to a single binding post and wired in series with the rheostat. Its compact, handy size and many possible ways of mounting make it adaptable to every receiving set. Price 25c at all radio dealers and supply houses.

THE CUTLER-HAMMER MFG. CO.

Member Radio Section, Associated Manufacturers of Electrical Supplies

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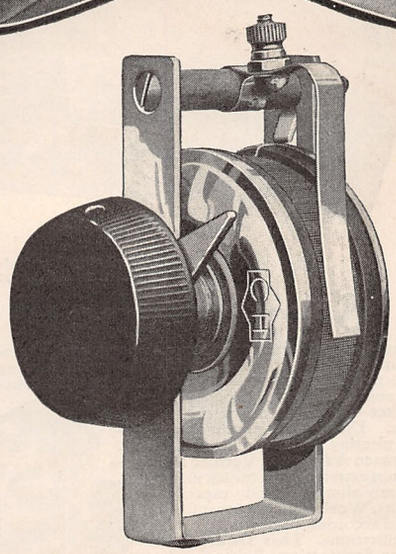


The C-H 30-Ohm Rheostat

The newest of the famous line of C-H Radio Rheostats. Built by the master builders of rheostatic control apparatus and engraved with their guarantee of satisfaction — a trademark you should demand on the vital instruments for your receiving panel.

Designed with a resistance of 30 ohms for the control of the new "A" type receiving tubes (C-301-A and UV201-A). Finished in dull satin nickel and ebony black. Arranged for panel mounting, pointer indicating, and furnished with genuine Thermoplax knob. The instrument your new receiving set deserves.

Type 11601-H9 . . . . . $1.50

One-half Million C-H Radio Rheostats Now in Use

CUTLER-HAMMER

The Receiver that Satisfies

Telmaco

Type B-R Receiver

fully meets the requirements of the discriminating purchaser because of the following features:

EFFICIENCY OF OPERATION: Securing volume, distance (1500 miles with single tube is not unusual), selectivity. Broadcasting stations one-half mile distant are tuned out by a slight turn of condenser dial.

EASE OF OPERATION enabling the novice to secure satisfactory results.

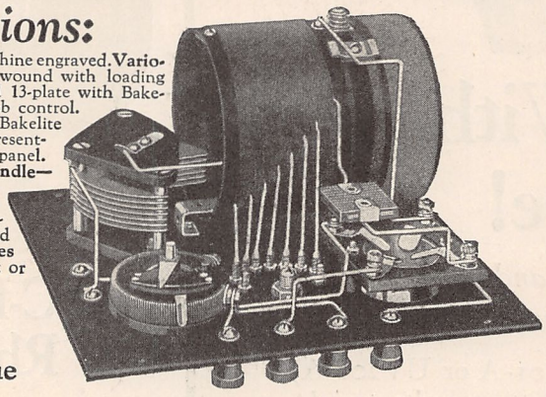
HIGHEST QUALITY OF WORKMANSHIP AND MATERIALS.

PRICE within the reach of everybody.

Manufactured exclusively for us by the Tri-City Radio Electric Supply Co., licensed under Armstrong U. S. Patent No. 1113149, October 6th, 1914.

Specifications:

Panel—Formica, grained and machine engraved. **Vario-Coupler**—**Telmaco** special silk wound with loading inductance. **Condenser**—Special 13-plate with Bakelite ends. **Rheostat**—Single knob control. **Socket**—Highly nickeled shell, Bakelite base. **Dials**—are polished, presenting pleasing contrast with dull panel. **Telmaco Adjustable Vernier Handle**—secures extremely fine tuning and entirely eliminates body capacity effects. **Workmanship**—manufactured according to **Telmaco's** rigid specifications. **This Guarantees Your Satisfaction.** Either 6 volt or 1½ volt tube may be used.



Price $25

The ultimate in value

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Quality Radio Exclusively

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If our salesmen have not reached you with our proposition, write or wire for it today

TELMACO Type B-A Two Stage A. F. Amplifier

Matches the above in size and construction. The greatest Amplifier value on the market. Price $20.00.

RADIO DIVISION

TELEPHONE MAINTENANCE CO.

20 S. Wells Street, Dept. B Chicago, Illinois

LEARN THE CODE AT HOME

"Just Listen—The Omnigraph will do the teaching"

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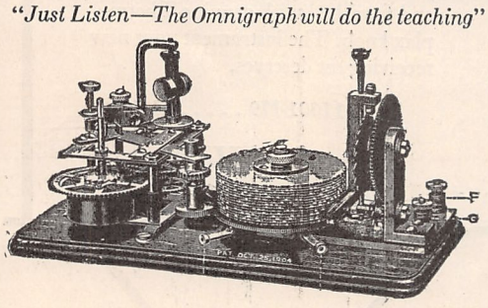
OMNIGRAPH



THE **OMNIGRAPH** Automatic Transmitter will teach you both the Wireless and Morse Codes—**right in your own home**—quickly, easily and inexpensively. Connected with Buzzer. Buzzer and Phone or to Sounder, it will send you unlimited messages, at any speed, from 5 to 50 words a minute.

THE **OMNIGRAPH** is not an experiment. For more than 15 years, it has been sold all over the world with a money back guarantee. The **OMNIGRAPH** is used by several Depts. of the U. S. Govt. —in fact, the Dept. of Commerce uses the **OMNIGRAPH** to test all applicants applying for a Radio license. The **OMNIGRAPH** has been successfully adopted by the leading Universities, Colleges and Radio Schools.

Send for FREE Catalog describing three models, $14 to $30. DO IT TODAY.

The Omnigraph Mfg. Co., 20 Hudson St., New York City

If you own a Radio Phone set and don't know the code—you are missing most of the fun

"In Germany an investigator by the name of Vogt has found a similar action in the ionic currents passing through the air between a Nernst glower and cold anode placed nearby. All of these electric reproductions of sound waves are naturally extremely weak, and must be amplified, by means of a series of Audion amplifiers, several thousand times before they can be applied to any useful purpose.

"More recently Dr. Phillip Thomas of Pittsburgh has demonstrated that a high-potential low-current discharge between two electrodes in air may be 'modulated' by sound waves. This is a return to the method which I showed in a patent taken out in 1906 for controlling very simply by the voice the high-frequency, high-potential currents in a radio telephone transmitter.

THE THERMO-MICROPHONE

"But I have found still another method of translating sound waves direct into electric currents without the imposition of any diaphragm. This arrangement, independently suggested to me by Mr. Theodore W. Case, is the reversal of the well-known 'Thermophone,' a device wherein an extremely fine platinum wire, through which is passed telephonic currents, reproduces these in the form of sound waves due to the alternate heating and cooling of the air immediately surrounding the extremely fine wire.

"In my Phonofilm work we have found in the same way that when a series of very fine and very short platinum wires are heated to a dull red from a local source of current the resistance of these wires changes, alternately increasing and decreasing in conformity with the sound waves impinging thereon; so that from a telephone transformer connected in series with the battery and this thermo-microphone, a remarkably faithful representation of the sound waves is obtained, even though the frequency of these be as high as 3000 per second. The sensitiveness of this device is greatly enhanced through a gentle stream of air, by fluid evaporation in the neighborhood, and by other auxiliary means. In a word therefore there now exist several ways of obtaining extraordinarily faithful reproductions of sound waves in the form of electric currents, entirely unlike the diaphragm methods on which telephone engineers have been working from the beginning of their art.

"Part of the sound records used in the Phonofilm have been made by utilizing one or the other of the new converters which I have just been describing. Of all the diaphragm types of transmitters unquestionably the electro-static type as perfected by engineers of the Western Electric Company, comes nearest to approximating perfection. While this is extremely insensitive compared with the best carbon microphonic type, there is no comparison between the fidelity of reproduction by the two means. But one listening in a telephone to the reproduction by means of the flame microphone, and then by means of the electrostatic microphone, will at once exclaim that the fidelity of reproductions in the first case is of quite a different order from that obtained even from the highly perfected diaphragm of the best electro-static microphone."

A Simple Single-Tube Super

(*Continued from page* 39)

use a 90- to 120-volt "B" battery. A 120- to 130-volt "B" can be used with a V.T.-2; with a V.T.-1 tube excellent results can be obtained if the plate-voltage is 45 to 60 volts.

At the loop terminal marked X, an outdoor aerial can be connected. This will bring in the distant stations more clearly. No ground is required, but, if used, it should be connected to the minus terminal

Become a Certified Radiotrician
Under Government License

The best paid positions in Radio go to those who hold the Government First Class Radio License. The *Certified Radio-trician* is the man chosen for the *big* radio jobs. He is the man who draws the largest salary in this new, big money field. And now you can easily qualify for this government license. You can become a Certified Radio-trician with a few weeks spare time study at home—and then can earn big money in Radio.

Certified Radio-tricians take charge of Broadcasting Stations, Government Land Stations, and Commercial Radio Stations.

Earn $2,400 to over $10,000 a year

The world is aflame with Radio. Never before in the history of the country has an industry leaped to the fore as rapidly as this great, new science. Hundreds of thousands of radio receiving sets are in operation—tens of thousands of sending stations will be erected—and this enormous craze is permanent. Even today manufacturers are months behind their orders! Improvements are being made every day which must increase the demand for radio equipment to even greater proportions than now.

Men of foresight, men of vision know what this means. Never before has there been such an opportunity, Radio-tricians are needed today everywhere. More and more will be needed as the demand for radio installation, radio operation, radio maintenance, radio repair, radio salesmanship becomes greater and greater.

Wherever you go, there are hundreds of radio sets to be installed—wherever you go, thousands upon thousands of dollars worth of radio equipment is being sold—wherever you go, there are radio sets to repair; and if you seek adventure, there are radio sending stations calling to you from ships and land stations all over the world.

The Pioneer School

The National Radio Institute has a record of over 8,000 students. It is the pioneer school. It teaches every phase of radio from the ground up. It teaches by means of actual practice, actual assembling of a radio outfit, actual operation of radio equipment. It teaches by problem and principle so that National Radio-tricians are in demand everywhere.

Here is a profession which is paying enormous earnings to men all over the country today — a profession that will make hundreds of men wealthy—a profession far more lucrative than that of any other technical or mechanical employment you can secure.

What Will You Do?

The world is aflame with radio. What are you going to do to "cash in" on the demand for men, for equipment, for experience? Are you going to sit idly by wondering what it is all about, or are you going to make the most of this, the greatest opportunity presented to men of ambition in 50 years?

Learn more about the wonderful opportunities in this wonderful new industry. Learn too how you can best take advantage of the big rewards offered in this field—how you can easily become a Certified Radio-trician in your spare time, and can qualify for the best positions in radio.

Write at once for new booklet "Your Opportunity in Radio," just published by the National Radio Institute. This is the turning point in your life. Upon your decision *this instant* may depend your entire future. Mail the coupon, or write a letter NOW—*for your own sake!*

National Radio Institute
Radio Headquarters
Dept. 13-G Washington, D. C.

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NATIONAL RADIO INSTITUTE
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Dept. 13-G, Washington, D. C.

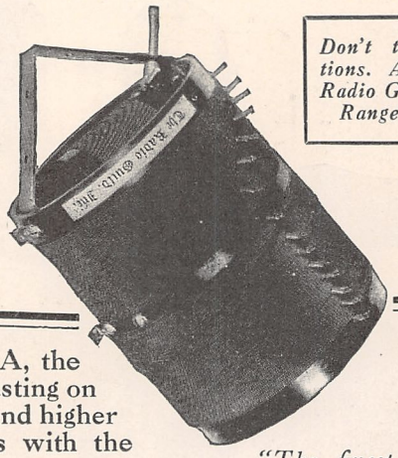
Please send me your catalog "Your Opportunity in Radio" describing your Home Study Course which will qualify me to become a Radio-trician.

Name .....

Address .....

City ..... State .....

The Radio Guild Inc.



Don't take imitations. Ask for the Radio Guild Multi-Range Coupler.

RECEIVE NAA, the new broadcasting on 710 meters and higher wave-lengths with the

"MULTI-RANGE" COUPLER

Increased production to meet the enormous demand permits reduction in prices.

"The finest bank-wound coupler ever produced."—N. Y. Evening Mail Laboratories.

Permits the easy construction of a complete radio receiver at low cost.

Multi-Range Senior, 170-3400 meters Now $9.00
Multi-Range Junior, 170-2000 meters Now $7.00

From your dealer or direct.

If your dealer cannot supply you tell him to write to us or his nearest distributor.

Read the Harkness Book on Super-Regeneration

48 pages, 30 photographs, wiring diagrams and mechanical drawings. The most complete book on the subject ever published. Explanation of the theory of super-regeneration is a revelation. Tells how to construct three different types of sets.

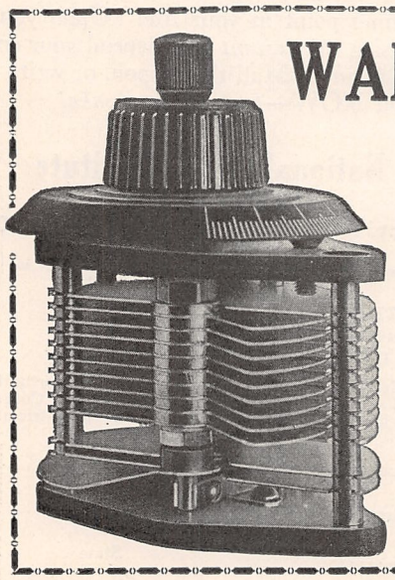
Send for your copy today—Price 50c. From your dealer or direct.

The Minneapolis Daily News Says:

"Radio books have come and gone in plenty. None has seemed to be worthy of special mention. One came this week, however, which absolutely demands mention, not to say praise, by its merits. It is THE CONSTRUCTION AND OPERATION OF SUPER-REGENERATIVE RECEIVERS by Kenneth Harkness."

The Radio Guild, Inc.

256 WEST 34th STREET NEW YORK N.Y.



WALNART Trouble-Proof RADIO Apparatus

The New Walnart Condensers

New patented construction prevents sagging and loosening. Guaranteed trouble-proof, cannot get out of line because stator plates are inserted into supporting studs at 3 points and firmly locked by punch-press. Plates of 20 gauge, high conductor aluminum. Strongest, most durable and finest tuning adjustment. Bakelite end plates. Electric break-down tested. You can pay more, but you cannot buy more service and quality. Vernier type, for extra fine tuning, includes Vernier Knob and extra plate.

LIST PRICES

No. of Plates	Micro F Capacity	Plain Type	Vernier Type
3	.00006	$1.50	—
5	.00010	1.60	—
13	.00025	2.25	$4.25
23	.0005	3.25	5.00
43	.001	4.00	6.00

WALNART ELECTRIC MFG. CO.

Dept. 306 1251-5 W. Van Buren Street, CHICAGO

of the "A" battery. In tuning the set proceed as follows:

OPERATION

Turn up filament near maximum. C-1, all out (minimum setting), variometer rotor at 45-degree angle to stator. C-2, all in (maximum setting). Adjust phones on head and slowly cut in C-1 until a sound like escaping steam is heard. Turn rotor of variometer until this sound is heard loudest, then vary the C-1 condenser until the whistling peculiar to the Armstrong circuit is heard. Signals should now be heard, at which time clear up with variometer, C-1 and filament rheostat.

The loop should be made to point towards the sending station, although it is not very directional. If an outdoor aerial is hooked on, the loop can point in any direction. A fixed condenser can be used in place of C-2, but this causes too much whistling.

For a Magnavox, a one-step amplifier should be used; however, the phones should be left in the circuit, the primary of the transformer being connected across the phone terminals, in parallel with the phones. Other loud speakers may be connected directly to the phone terminals. The Baldwin Type C works exceptionally well.

Super-Regeneration with WD-11 Tubes

(*Continued from page* 38)

wire about 30' high and 200' long. Some work was done with a two-foot loop in series in the grid circuit, about 300 miles being covered in daylight. Stations were heard on the antenna, from all points, the furtherest being Los Angeles, about 1300 miles from Kansas City, where the station described is located. The circuit is quite sensitive to untuned disturbances, the switching on of an electric light being audible with the phones several feet away, which is of course a disadvantage. Super-regeneration, however, has a great future, and an excellent present.

Correspondence From Readers

(*Continued from page* 45)

and then lectures his audience on the rottenness of the amateur, what a scoundrel he is, etc., the reason being, we believe, that the sets he sells will not tune local interference out. I was at his place once and in the presence of several people, tuned WFAA in while two powerful local C.W.'s were going, and only using 1½" coupling, got the concert absolutely clear of C.W. mush or key click. The owner looked as if he were going to have a fit (of rage) but I did not think anything of it at the time. He evidently didn't want it known that it is possible to tune amateurs out.

Is it any wonder the amateur is "doomed" with lunatics like that man at large?

In the second prize manuscript Mr. Marsten claims that the single-circuit tuner has less adjustments to be made than the three-circuit. I must differ with him. On a single circuit there are three adjustments, the antenna condenser, inductance tap switch and regeneration control. On a three-circuit there are four, tuning condenser, (primary) inductance tap switch, regeneration control and coupling. The coupling on a three-circuit tuner *never needs adjustment*, being just left with the secondary at about 45 to 60 degrees from tight coupling, and is the only control which is not on a single-circuit tuner. I have built a perfectly good three-circuit tuner with *fixed* coupling of about seven inches, which gave as good selectivity as one could get with any set. Paul Godley

Using the MAGNAVOX

IT is the Magnavox owner who gets the utmost service from Radio.

While the Radio enthusiast constantly strives to better his receiving equipment, Magnavox Reproducers and Power Amplifiers are units which no other apparatus can replace.

The only correct principles of sound reproduction and amplification are embodied in Magnavox construction.

Magnavox Reproducers and Power Amplifiers can be used with any receiving set of good quality. Without Magnavox, no receiving set is complete.

Magnavox R3 Reproducer and 2 stage Power Amplifier **$90.00**

R2 Magnavox Reproducer with 18-inch curvex horn: the utmost in amplifying power; requires only .6 of an ampere for the field **$60.00**

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Model C Magnavox Power Amplifier insures getting the largest possible power input for your Magnavox Reproducer.

AC-2-C, 2-stage, $55.00
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7R

Helping to Keep the "Stay-at-Homes" happy

RADIO has banished that dull, lonely evening idea once and for all—the "stay-at-home" nowadays can choose his own brand of entertainment from a number of programs practically every hour.

But a Radio set is only as good as its *reproducer* — make sure you have the Magnavox (electro-dynamic) Reproducer Supreme.

Magnavox products can be had of good dealers everywhere. Send for copy of unusual booklet.

The Magnavox Co., Oakland, California
New York: 370 Seventh Avenue

MAGNAVOX Radio
The Reproducer Supreme

The Radio Guild Inc.

Ordinary Vario-Couplers
Are Useless With
Radio Frequency Amplification!

If the sensitivity of a receiver is increased by means of radio frequency amplification, interference will also be increased and will render the amplification more of a drawback than an advantage **unless the tuning device is made more selective.**

The New Radio Guild
"Radio Frequency Coupler"

is especially designed for use with radio frequency amplifying circuits and provides just the proper variation of coupling to ensure selective reception. It makes reception with an outside aerial as selective as with a loop but with a much greater receiving range. Send for folder R.F. 7 giving full particulars and hook-ups.

Short-Wave "Radio Frequency" Coupler (200-550 meters).....$6.50
Multi-Range "Radio Frequency" Coupler (200-2000 meters).....$8.00
Bank-wound loading coil (for secondary circuit of Multi-Range "Radio Frequency" Coupler) $4.00

From your dealer or direct

If you have never experienced the thrill of tuning in a distant radio transmitting station with a receiver made by your own hands you have missed the greatest pleasure of radio.
Learn how to properly design and construct a real "long-distance" set with radio frequency amplification. Read the

NEW BOOK BY KENNETH HARKNESS
"The Theory and Practice of RADIO FREQUENCY AMPLIFICATION"

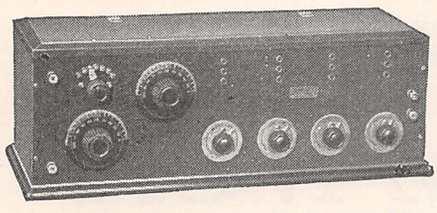
Every phase of radio frequency amplification is thoroughly explained with scores of photographs, drawings and wiring diagrams. Complete instructions are given to enable the home construction of various types of radio frequency amplifiers and complete receivers. For the first time the construction of the best radio frequency transformers is given in detail with photographs. Tells you how to make a high frequency oscillator covering all wave-lengths. Complete details, constants and photographs of a Hazeltine Neutrodyne Receiver.

Send for your copy to-day. Price $1.00

The Radio Guild, Inc. 256 West 34th Street, New York, N. Y.

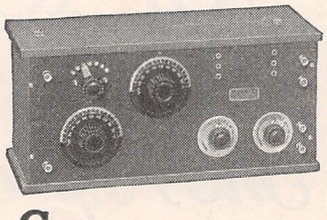
Specialists in radio frequency amplification.
Distributors of DX radio frequency transformers.

MIRACO GETS 'EM 1500 MILES AWAY!



Users of MIRACO Radio Frequency Broadcast Receivers in either model shown report wonderful results. St. Louis hears Schenectady—Davenport hears Newark—Cincinnati hears San Francisco.

Reception is clear and distinct, tuning is very sharp and there is practically no interference.



MIRACO sets may be used with either 1½ Volt Dry Cell or 6 Volt Storage Battery.

Model M-W, 4 tube set—price $54.50
Model K, 2 tube set—price $29.50.

Order your MIRACO set today.

DEALERS — AGENTS — DISTRIBUTORS
Write for our proposition TODAY.

The Midwest Radio Company,
804 Main Street : : : Cincinnati, Ohio

made an apt comparison between single and three-circuit tuners some months ago. He said that "an automobile without gearshift, clutch, timer, carburetor control or accelerator, but just switches for starting and stopping would be a sorry affair. Electric autos are built that way and on the open road they always get the dust." However, he assumed that the three-circuit tuner has more adjustments, which I have found not to be the case. Personally, I prefer honeycombs for broadcast reception, as does anyone else who has tried them and learned how to use them.

OLIVER ROSEBANK.
960 Woolwich St., Guelph, Ont.

We are glad to publish this letter, and are also glad to answer the question: "What, then, is or was, the amateur doomed to?"

The Editor of this journal will pay $100.00 *to any one who can show where, in our published articles in* RADIO NEWS, *we have at any time, even vaguely, mentioned or hinted that the amateur was doomed on account of his interference. This is a thing that was furthest from our thoughts.*

When we printed the cartoon, in our October issue, we meant to show by it that the wave of radio broadcast popularity was swallowing up the amateur. By "swallowing up" we did not mean putting him out of business, but, rather, that there were about 500 *broadcast listeners against one lone amateur, and that if the amateur did not do something to make the country sit up and take notice of him, he would be smothered.*

We took the job upon ourselves of making the amateur popular with the 999 *out of* 1,000 *people in his community who do not know him now. We maintained, and still maintain, that the usefulness of the amateur to his country should be vastly greater than it is today.*

It is our fondest dream to see the amateurs outnumber the broadcasters, instead of the broadcasters outnumbering the amateurs, and that is what we mean by "Is the Radio Amateur Doomed?" If this language is not intelligible to any of our readers, we shall tackle it again in some other way, if you wish, but we shall always come back to the same point: WE WANT THE AMATEUR TO BE ON TOP OF THE PILE, NOT AT THE BOTTOM.

Whatever method is used to bring him to the top, if the method is a good one, will suit us. THE AMATEURS IN THIS COUNTRY ARE THE ONES WHO SHOULD LEAD THE BROADCAST PROCESSION, INSTEAD OF HANGING ON AS A SMALL MINORITY.

Think it over!—EDITOR.

GOOD DOPE

Editor, RADIO NEWS:

Having tried out a number of so-called filament rheostats with varying results, and my limited search through your laboratory reports did not disclose any technical data, it seems that a vital part of an efficient receiving set has been overlooked.

A large assortment of metals and alloys are used for resistances and each gives good results in some specific way.

These materials ranging from pure Norway iron with a resistance of seven times that of pure copper, to nichrome II, with a resistance of sixty-six times that of copper, and carbon and graphite in various compounds are also used.

If we expect to hold the current in the filament circuit at a constant value with a rheostat, this rheostat must be a precision instrument, and the resistance element must be made from material the temperature coefficient of which (change of resistance with change of temperature) is nill.

The temperature co-efficient of carbon and graphite and the co-efficient of contact resistance (change of resistance of contact with both temperature change and change of

HOW I SAVED MY HAIR!

The Tragedy of Baldness

BY ALBERT WOODRUFF

WHEN the barber told me my hair was getting thin I merely smiled and let it go at that. When my wife said, "Bert, I do believe you are becoming bald," I gave a little laugh and passed it off with a jesting remark. I took the gibes of my friends in the same spirit—and I laughed when the comedian at the theatre made his "cracks" about candidates for the "bald-headed row."

But it wasn't until my business associates commenced to notice that I was rapidly becoming bald and gray that I worried. For while I was just as full of pep and vim as I had ever been—while my business judgment was just as keen as ever, yet I worried for fear my associates might think of me as heading toward the "has been" class. I decided to try to save my hair—if it could be saved.

Then I became a slave to hair tonics. If a tonic was new I bought it on sight. I tried every kind of shampoo that I heard of. I was a victim of the barber's wiles. The money I spent—and all to no purpose. My hair continued to come out just as fast as it ever did before I had tried to stop it. Every time I combed my hair it told the story.

How I Prevented Baldness

One day I read a very interesting advertisement by the celebrated Physical Culturist, Bernarr Macfadden. Now, it so happened that I had seen Mr. Macfadden several times and I knew that he himself had wonderful thick hair. Naturally I was interested—although it was news to me that Mr. Macfadden had made a study of the hair and had written a book on the subject, entitled, "Hair Culture."

In the advertisement Mr. Macfadden said he was amazed to learn how little really authoritative information had been written about the proper care of the hair and scalp. He said that one need not let the hair grow thin and gray. He said that if the hair is falling out or getting gray a reasonable amount of proper care will restore it, unless one is completely bald. And this same care will keep the hair strong and healthy throughout life. He spoke of simple, natural and effective methods for treating the hair and scalp by following a few laws of nature. Then he casually mentioned that he was startled at the tremendous demand that existed for his comprehensive work. In fact, the first edition of his treatise was very quickly sold and a new edition had to be printed to take care of the orders that were flooding in on each mail.

I made up my mind right then that since Mr. Macfadden had written the book it was sure to be very practical—and the fact that so many had been sold clearly proved to me that the treatise must be filling a popular demand.

So I just jotted my name and address down on the coupon and returned it. When I received the book on five days' free examination I immediately read it very carefully and that very same night I started to follow the few simple rules. I must confess that within a very short time I noticed a decided improvement in the growth of my hair—it became thicker and more glossy. Then dandruff disappeared. Today, after following the rules laid down in this new method, I have just as fine a head of thick hair as you would see on any man—even a young man of eighteen or twenty has no thicker or glossier hair than mine. In fact, many haven't anywhere near such fine hair. The grayness has all disappeared and my hair has the glowing color of youth. My wife and children also adopted the rules which we discovered in Mr. Macfadden's treatise entitled "Hair Culture" and their hair is the admiration of all their friends. If you will examine the book I am quite sure that you will agree with me that it is one of the most valuable—if not the most valuable—and instructive books ever written on Hair Culture. *Albert Woodruff.*

"Only a short while ago my hair was falling out by combfuls, yet today I have fine, thick hair, with not the slightest trace of baldness or dandruff."

Women! Keep Your Hair Youthful

If your hair is graying prematurely you have every reason to hope that it can be stopped and that much can be done toward restoring it to its original youthful and becoming color.

If it is losing its luxuriant quality and glossy sheen the few simple rules taught by Bernarr Macfadden in his new book HAIR CULTURE will enable you to bring about an almost unbelievable improvement. Why spend time and money at the hair dresser's when you can give your hair a better home treatment in only a few minutes a day by this new method? You can easily have hair that is wonderfully silky in texture and your scalp can be cleansed of every trace of dandruff or scurf.

Bernarr Macfadden's Secrets of Hair Culture

These chapter titles will give you an idea of the scope and value of this remarkable book:

Bernarr Macfadden. Note his thick, luxuriant, healthy hair.

- Hair as an attribute to beauty.
- Facts everyone should know about hair.
- Care of healthy hair.
- How to care for baby's scalp.
- Facts about soap and shampoos.
- The cause of hair troubles.
- Dandruff.
- Dry Hair, Oily Hair, Split Hair.
- Falling Hair.
- Baldness.
- Gray Hair.
- Hair Dressing.
- Eyebrows and Eyelashes.
- Superfluous Hair.
- Hair tonics.

Send No Money

If you would like to take Mr. Woodruff's advice we will gladly let you examine "Hair Culture" for yourself, without obligation, and see how easily you can follow the methods that should bring new life, new lustre and luxuriance to your hair. Dont send one cent in advance—just fill in and return the coupon and the book will come to you by return mail. When the postman hands it to you, deposit only $2.00 with him. Then after you have kept "Hair Culture" for 5 days—after you have tested the methods—if you are not absolutely satisfied return the book to us and your money will be promptly refunded. If, however, you decide to keep this remarkable book, as you surely will, there are no further payments of any kind to be made—the book becomes your property for the one sum of $2.00 which you deposited with the postman.

MACFADDEN PUBLICATIONS, Inc.
Dept. R.N.-7, Macfadden Building
1926 Broadway New York City

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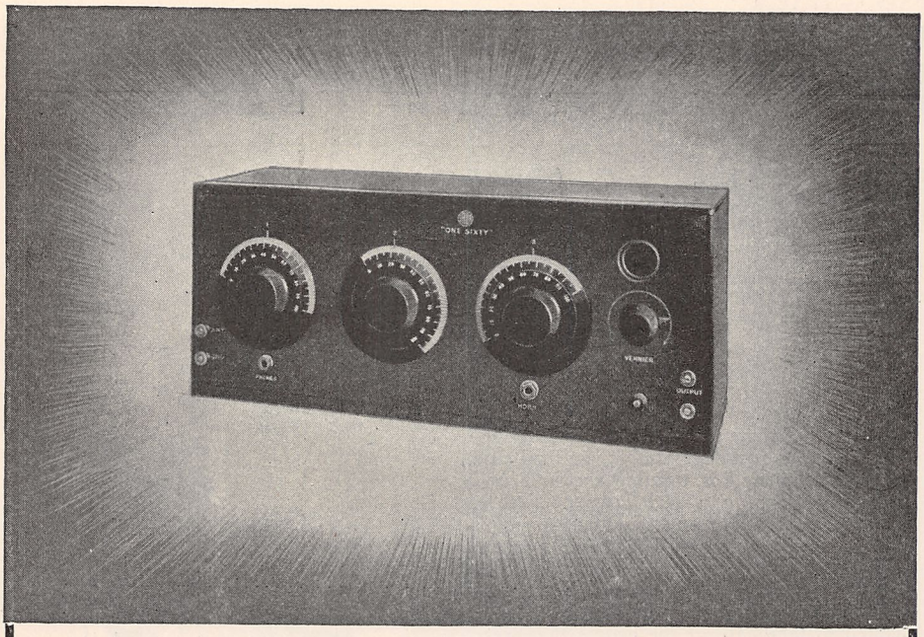
1926 Broadway, New York City

Without obligation on my part, please send me a copy of Bernarr Macfadden's Book giving me all of Nature's simple methods for preserving and beautifying the hair. I will pay the postman $2.00 on arrival, but I also have the privilege of returning the book within 5 days after receipt and you will refund my deposit.

Name .....

Address .....

.....



NEUTRODYNE—

NEUTRODYNE the marvelous new radio receiver circuit used in the FADA "ONE-SIXTY" receiver.

Using only four tubes in the FADA "ONE-SIXTY" broadcasted concerts can be received from stations 1500 and 2000 miles away. Denver, Colo.; San Antonio, Texas; Havana, Cuba; and Los Angeles, Calif., are some of the far distant stations heard on a loud speaker in New York City.

Send for bulletin and learn about the FADA "ONE-SIXTY" that can be yours for $120.

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SHORT CUT ANTENNA

Replaces aerials, loops, electric light plugs, etc.
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Reduces *Static* and other interference.
Gives clearer signals and truer tone.
Works on all Standard vacuum tube sets.
Postpaid anywhere for $5.00

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Tested before and after mounting crystal guaranteed. Manufacturers, Jobbers and Dealers write for prices.

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pressure) eliminate their use in precision instruments.

Of the large assortment of resistance alloys there are only a very few that are suitable for use in filament rheostats, and these were developed by their makers for use in precision instruments.

The material used to support the resistance element must also be selected with regards to its co-efficient of expansion and heat conducting ability; as proof of this I quote a statement made by Mr. W. Wilcox of New Bedford, Massachusetts, in his letter to RADIO NEWS for January, page 1300.

"I have been skeptical about buying strange rheostats. The wiring comes loose very easily on some."

Mr. Jesse Marsten in his article, "Radio Head Sets," on page 1279, RADIO NEWS for January, states that with the advent of the radio boom, carloads of miscellaneous junk made its appearance on the market, and also that it would be safe to say that a number of the new makers of head sets are not really familiar with the theory and design of telephones. These statements hold true with radio equipment other than head sets.

The new Radio Bug, having contracted the disease, is willing to pay dearly for the prescription written by a dealer who diagnoses his case on a basis of profit, and who in many cases knows nothing about the article sold except what the maker claims for it.

Radio, still in its infancy, has come to stay, and we can protect ourselves and future BUGS by purchasing and recommending articles bearing the approval of some reliable laboratory.

J. L. HERMAN, Gray, Maine.

A MOIST HOOK-UP

Editor, RADIO NEWS:

Although not a subscriber, I can hardly wait for RADIO NEWS, and it seems to me that it is always a week late, but when I do get it I more than make up for lost time.

To the "Radio Bugs" who are always looking for something new I ask them to try the following hook-up.

From your grid condenser connect a small piece of copper tubing next to your plate and let it extend about one inch through your panel, bending the end downward. Next get a small copper cup and place same under this "spout"; then tune in Havana, Cuba. If your grid leaks, watch out for the prohibition agent, for you may get a drink from Cuba.

Hoping this little suggestion meets with the approval of the "Radio Bugs," I present it as an original hook-up.

BEN WIRTHLIN, Cleveland, O.

CONCERNING SINGLE CIRCUIT TUNERS

Editor, RADIO NEWS:

I have read so many communications from different amateurs in RADIO NEWS, in which they all take a rap at the single-circuit tuner, which is the reason why broadcast listeners get sore at them; and I wish to remark that with the average amateur transmitter tuned to 200 meters, and not properly rectified, or filtered, a portion of their wave skips up to 400 meters or better, and it is no fault of a single circuit tuner or any other tuner, if it does not get rid of this type of wave.

Furthermore, three-fourths of the cards amateurs receive from brother amateurs, admit they use a single circuit tuner; and I venture nine-tenths of the real DX reception are by a single circuit type, as this tuner properly constructed tunes SHARP, and this is due to low resistance and low capacity losses, which in a variometer coupler type are very considerable. There are today amateurs who think a set can not be regenerative, unless it is of the variometer coupler type, and it seems to me that the new race of experimenters now coming along is more anxious to improve their sets, try new cir-

cuits, etc., than any of the old hams. An amateur should not find fault with the single-circuit tuner until he makes an honest-to-goodness test with his pet, and finds it inferior, and he will notice that the waves emitted by broadcasting stations are very sharp and must be tuned to a hair, and that the average C.W. signal is much easier to get just right, as it can be read over a wider range of tuning.

The single-circuit tuner gives the loudest signals, is easy to tune, brings in DX stations regularly, that are never heard on a variometer-coupler set, is relatively free from capacity effects and losses, is cheap to construct and is the favored set by long odds among the manufacturers.

Using one of these single-circuit tuners, I have tuned in eight stations on the Pacific Coast in one night, which is 2,200 to 2,900 miles from here and on Nov. 8th, I heard KHJ on one step so fine that I sent them a detailed log of their program, including remarks by the announcer word for word and the names of the artists, composers, etc., of over 50 different numbers. In fact any station 1,000 to 1,500 miles away is no trouble to get. I can get Fort Worth, Texas, and Havana with loud speaker on two-stage audio, regularly, and will guarantee to get California any night reasonably free of static.

There are some commercial and ship stations that operate at around 400 meters and amateurs are sometimes blamed for this interference, but a properly rectified and filtered D.C. C.W. signal at 200 meters will not interfere with broadcasting; but do not give the single circuit tuner the razzberry because you do not know how to build a good C.W.

W. W. Brackenridge. Harrison, Ohio.

SOMETHING TO THINK ABOUT

Editor, Radio News:

Is there anything that can be done to prevent the daily growing interference radiated by receiving sets tuning up? I am sure that *this is the greatest obstacle to the continued growth of the popularity of radio.*

Since the installation of my set, which is a good three-circuit one, in November last, the interference from whistling tuners has become steadily greater; every new set sold or built in this locality seems to add its squeals and howls to those already in operation; and now, it is a most unusual thing to be able to enjoy even half of any concert. Our friends, all of whom would purchase receivers and subscribe to the magazines if these conditions were changed, are becoming prejudiced against radio because the miserable noises from neighboring sets outweigh the pleasure of listening, after the novelty of distant reception has worn off. Our evenings will have to be devoted to other means of entertainment unless this interference is stopped in some way.

From a strictly business standpoint, will not the continued sale of interfering receiving sets SOON reach a point where the public will become disgusted with radio entertainment, because the more sales, the more interference there will be? If I could buy a set which is proof against this type of interference, I would gladly do so, but the most expensive sets which I have seen are entirely helpless when several neighbors tune in their regenerative receivers. There is no use in telling them to tune in without the whistle, as this is more difficult to do and they will not make the effort; the receiving sets must be so constructed that they CANNOT interfere under any conditions if the public (of which I am but one) is to be in favor of radio entertainment. If this interference be stopped, everybody will have radio in their homes; if continued, only a few will be interested in the awful noises that come through their phones.

The broadcasting stations are transmitting strong and clear, their programs are wonderfully pleasing and beneficial; it seems too

If He Had Passed It Up

He would still be a laborer at $2.00 a day. No money, nothing ahead but hard work, longer hours—and regrets.

But He Didn't Pass It Up. He decided to learn MECHANICAL DRAWING. He buckled down to work with the Columbia School of Drafting. When he had a quiet half hour to spend he spent it—as a wise man spends money—to get full returns.

Made $275 Extra in 3 Days. He recently received $275 for one drawing that only took him three days to draw.

Now How About You? Are you working up hill or down? Count the money in your pay envelope next pay day. You'll find the answer there.

Make $35 to $100.00 a Week. We will train you to be an expert draftsman in your spare time at home by mail. There's lots of room for you if you act now.

Promotion is Quick. WE'LL QUALIFY YOU for a high-salaried position in the drafting field and keep you in touch with openings for draftsmen in the big machine shops, industrial plants and United States Government departments. Men who start as draftsmen are often advanced to Chief Draftsman, Chief Engineer, Production Manager and so on.

Get the *Right* Training. Mr. Claflin, the founder and director, stands personally in back of the Columbia School of Drafting. You spend no time in long-winded theories—useless and expensive to you. You start on actual drawing work the day you receive your first lesson.

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Success Calls Men of Action Only. If you are a man of action clip the coupon now and show that you are a man of action. Keep right on top of this opportunity to make real money. Don't go looking for a pair of scissors. Tear the coupon off and mail it right now. We have a special offer for those who reply promptly. Get started now.

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Free Training as a Drafting Specialist. After completing the course in mechanical drawing we'll train you free in your choice of one of our special elective courses.

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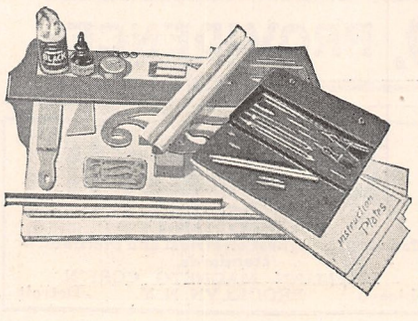

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Enter my name for a subscription to "The Compass" and without obligation to me, please send me your illustrated book on Drafting, telling how I can secure your complete home study course and your help in securing a position as Draftsman.

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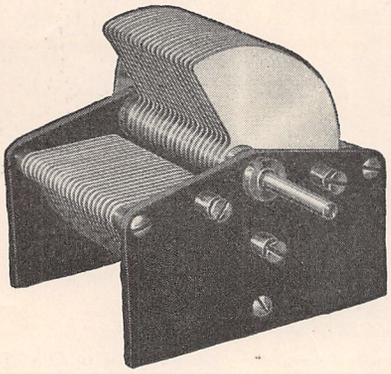

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Made to meet a demand for quality —highest efficiency, 3 plate, 23 plate and 43 plate sizes.

The Carco Coupler

Just the thing for the popular receiving set. Bakelite tube, and rotor, silk covered wire, perfect contacts.

We invite Dealer and Jobber inquiries.

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Pacific Coast Branch
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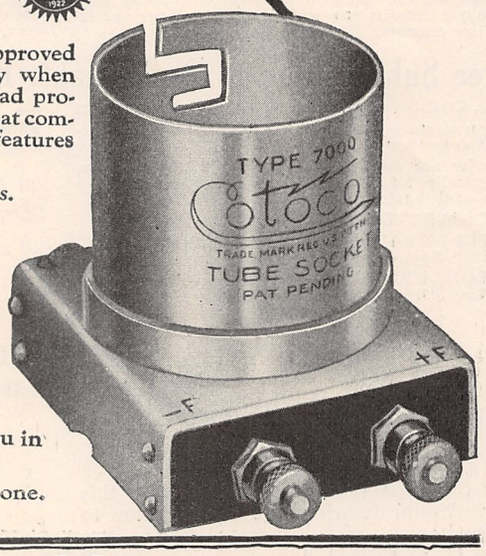
"Built First to Last"

This little beauty was approved by our engineers only when convinced that they had produced the one socket that combines all the essential features of a good socket.

1. *Positive Cotogrip Contacts.*
2. *Hard Rubber Insulation.*
3. *Rugged Construction.*
4. *Compact Design.*
5. *Concealed Mounting.*

It is impossible to show the unique mechanical action of Cotogrip contacts in a photograph. It is different from any other socket you have ever seen. This socket will interest you in every way.

You ought to have one.
Ask Your Dealer



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A well designed Record Book. Indexed and arranged to record all details.

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EISEMANN

RADIO UNITS

Made to the highest electrical and mechanical standards.

EISEMANN MAGNETO CORP'N

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bad that all this should be spoiled by the interfering radiation of receiving sets daily becoming more intolerable.

HAROLD S. BRIGHAM, Kingston, N. Y.

A CRITICISM

Editor, RADIO NEWS:

It is to be regretted that in an article "On Transmission of Waves," by so eminent a pioneer as Sir Oliver Lodge, there should be contained a teaching which to say the least is in utter variance with the requirements of Poynting's Theorem. The latter theorem, by the way, is mentioned in the text of the contribution in question.

To discuss details of Poynting's highly mathematical development would be much beyond the range of the mathematical equipment of the ordinary amateur. Yet, if Poynting's requirement for coincidence of phase holds at all over any envelope about the antenna sending station, it must always hold, EVEN OVER THE SURFACE OF THE ANTENNA ITSELF. It is to be remembered that Heaviside in his Electromagnetic Theory, Vol. III, insisted on considering the energy as being generated ab initio at the surface of the antenna wire in proper phase relationship. To do otherwise would be to imply that the one lagging phase traveled forward at a speed greater than the speed of light in order to overtake the one ahead of it, still occurring within the quarter wave distance.

The matter of the Poynting's Theorem, insofar as it affected envelopes within or without the quarter wave distance, had already been taken up in a technical journal in England when discussing Professor Howe's recent work. I can see no useful purpose in urging amateurs to believe that stationary waves preponderate on the antenna, and by some hocus pocus emerge as progressive waves into the ether.

What perhaps needs most understanding in Hertz's mathematical development is that a self induction element such as the coupling coil mentioned by Sir Oliver Lodge is not even suspicioned as necessary. Why, then, the lumped overhead capacitance balancing with an assumed inductance?

A. PRESS, Rantoul, Ill.

UNCLE JOHN LIKES IT

Editor, RADIO NEWS:

Under the "Correspondence from Readers" heading, your April issue, I notice several letters relative to the negligence of announcers with regard to giving their call letters.

These letters voice my opinion exactly. Many times the operators fail entirely to give the letters, or wait so long that one feels like wringing their necks.

I am deeply appreciative of their efforts, and realize that to a certain extent I am getting "something for nothing," in the way of radio entertainment, and yet it seems a small thing to ask that they be a little quicker in announcing, and that they announce after *every* selection, not after every three or four.

One letter in particular I noticed, that from J. F. Slocomb, Cambride, Mass., wherein he mentions hearing a station testing, "One-two-three-four Hello-hello-hello-o-o," followed by a "yoohoo" whistle and phonograph records. May I suggest that there is little doubt but that this was WQAA, station of Horace A. Beale, Jr., in Parkesburg, Pa. This is Horace's favorite way of testing. He also speaks to "Uncle Johnny," in Bondsville, Mass., which Mr. Slocomb may also have heard. We all know how it is to listen to a station for a half hour, only to miss the letters, and I hope that this may be of some help to Mr. Slocomb.

SIDNEY E. WALTON, Newton Centre, Mass.

FROM A CANADIAN OP

Editor, RADIO NEWS:

Sure was glad to see that you have in-

cluded a page for the "Seagoing Op's," so that we now have a magazine devoted to the game that takes care of everybody from the "Listeners In" to the professionals. To date I have as yet to come across a journal that covers radio so widely as does RADIO NEWS, and think that the Seagoing Operators will appreciate it more than ever.

Regarding the letter of Mr. R. Lister, in the March number, I would like to take exception to one or two of his statements. He asks: "why not raise the wave-length of the broadcasting stations to 650-1000 meters, as a means of getting away from the commercial spark QRM?" Surely he has heard spark signals from 600 to 1000: 600-m. ship stations; 800-m. compass stations; 925-m. Naval stations; and the Radio Beacons on 1000, with their almost continuous string of distinguishing dashes on a hazy or foggy day?

He also mentioned the QRM on 300 from ships, but I have had no trouble with these on the American side as most of the ships are now tuned to 450 meters. Nearly all ships are fitted with three wave changes so the 300 meter length has been replaced by 450.

The 450 wave does interfere with the Canadian Broadcasting stations, as they are all tuned to about that wave, but should not bother receivers west of the Lakes.

Personally I believe that the range of wave-lengths at present used by the Broadcasting Stations is quite suitable, but that there are too many stations working at once and too many on the same wave. Why not cut down the number of stations and allow each so many days per week to broadcast, the other stations in their immediate vicinity remaining quiet? Also give each station in a given district a separate wave-length, within ten meters or so of each other and allow no two stations of the same wave-length to operate at the same time unless they are a certain distance apart, depending on their power and range?

This should cut down much of the interference at present experienced by those using single circuit tuners or situated in a district that is smothered with broadcasting stations.

He also states that Canada has no Radio Compass Stations as far as he can find out. She has, and very efficient ones at that. It might surprise him to know that they have a longer range than any I have yet worked. There are three of these stations on the Atlantic Coast of Canada and one, owned by the Canadian Government, in Newfoundland. These stations operate on a different principle and have a longer range than those of the U. S. Government. They do the work of twice their number of the latter type for the length of coast line that they cover.

The length of the coast line does not permit of any more, with the possible exception of one or two in the Gulf of St. Lawrence, or at the entrance to the Straits of Belle Isle.

Looking forward to many letters from Seagoing Op's and wishing you the best of success.

CHAS. G. FISHER,
Operator, S.S. *Canadian Victor.*

DX ON SHIPBOARD

Editor, RADIO NEWS:

You may find it of interest to know of some long distance reception of broadcasting stations in the U. S., which was done in the harbor at Cartagena, South America, between 12 and 1 on the morning of March 10th. All stations came in clear and distinct, although the static was bad and QRM from nearby ships on 450 meters interfered a little.

The receiving was done on a honeycomb set with detector and one step audio, the QRN making it impossible to use more.

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These (and many other) Institutions use "ESCO" Motor-Generators for Wireless Operation

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Write for New Bulletin 237A.

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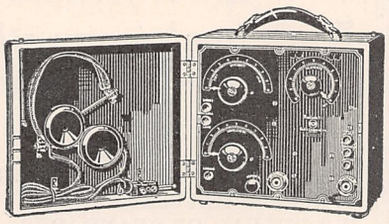
The New Portable Set for Summer!

Ready for Operation

Radiola II may be installed anywhere and will bring in broadcasted programs from far and near every evening.

The big feature of this set which makes it entirely self contained and almost self selling is the use of the new UV-199 Radiotrons. Low consumption of filament current .06 (six one-hundredths) Amp. allows the use of small dry batteries within the cabinet. Selectivity and sensitivity combined with the clear quality of tone reception puts the Radiola II in the lead for the best selling portable set. Handsome, beautifully finished, and self contained in a case about the size of a Corona Typewriter. Radiola II portable set brings to you Radio programs as your source of entertainment during your vacation.



Specifications

Regenerative Tuner.
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Two telephone jacks.
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"Pioneer" Instruments Will Solve Most of Your "Summer-Static" Problems

With nearly four times as many broadcasting stations to tune into as you had last summer, and with the remarkable hot-weather performance of "Pioneer" instruments, radio fans can enjoy their sets this summer, as never before.

If you are having annoying static interference let your dealer fix you up with the necessary equipment of

"Pioneer" Variocouplers $7.00
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With the understanding that *they will greatly improve your reception* or be returned for full credit.

The molded Bakelite shells, the close-coupled design of these instruments, together with our use of coarse silk-wound (not cotton) rotor wiring, and the precision-workmanship of every detail of construction, will give you the *mastery* over a lot of trouble.

If your Dealer does not carry the "Pioneer" line, send your order and remittance to us together with name and address of dealer whom you wish to favor.

Circular free.

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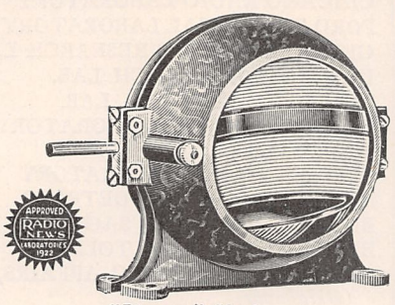
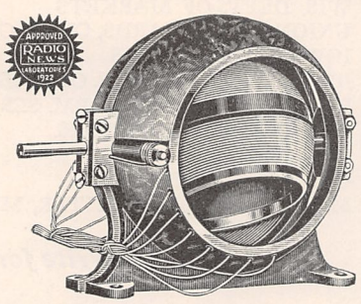


"Pioneer" Variometer

Price, each, postpaid $6.50



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Quite a few more stations than those on the list below were received, but due to interference, etc., it was impossible to determine who they were. The list is as follows:

WBAP—Fort Worth Star-Telegram, Fort Worth, Tex.
WIP—Gimbel Brothers, Philadelphia, Pa.
WSB—Atlanta Journal, Atlanta, Ga.
WGY—General Electric Co., Schenectady, N. Y.
WMB—Commercial Appeal, Memphis, Tenn.
KFI—Los Angeles Times (?), Los Angeles, Cal.
KPO—(?), San Francisco, Cal.

B. H. HAVENS,
Radio Op.,
S. S. *Metapan.*

2 OM, America's Best All-Around Amateur Station

(*Continued from page* 40)

U.V.-202 (5-watt tubes), two U.V.-202 and two Western Electric E tubes. (It was while using this combination, during the recent trans-Atlantic tests, that C.W. signals from station 2OM were reported in England.) The radiation averaged between 2 and 2.2 amperes, using a 500-V. D.C. generator. One and two UV.-203 tubes and a 1/4-K.W. "input" de Forest tube have also been used. With the latter tube, a record of two-way daylight communications was established with Station 9DYN, Kempton, Ill., an approximate distance of 800 miles.

Plate current for these tubes is supplied by a home-made high-voltage transformer, wound on an old Thordarson ¾-K.W. spark transformer. Voltages from 750 to 1600 volts can be obtained, also from a 500-volt D.C. motor generator, which has been geared up with belt-drive pulleys, and will deliver over 750 volts D.C. Filament current is furnished by a 200-watt Acme filament-lighting transformer, which has been rewound to give the following voltages, with a center tap, 6, 12, 18 and 24 volts, and will pass enough current for a ¼-K.W. tube. This voltage is regulated by a home-made rheostat in the primary circuit, which works on slider adjustment. Two .5 millihenry reactors and filter condensers of from 1 to 3 mfds. are used to smooth out the ripple for pure, direct current. One D.L.-200 H.C. coil is used for a radio frequency choke. Radio Corporation sockets are used. Separate grid condensers are employed on each tube of .002 mfd., also separate grid leaks of 2500 to 5000 ohms resistance. The inductance is home-made—a large tube, 7" in diameter, wound with 38 turns of No. 12 wire. The Hartley circuit is employed with a tuned ground and counterpoise. Many other circuits have been experimented with. Plate milliammeters, filament voltmeter, grid milliammeters, and T. C. ammeters give readings on different circuits while the set is in operation.

Experiments are being made with a 40-jar chemical rectifier, and a synchronous rectifier, to obtain D.C. A large C.W. tube transmitter is being designed for use this fall.

THE RECEIVER

The receiver which has done exceptional long-distance work on all waves which it covers, was designed and built by F. B. and W. H. Ostman, and embodies some excellent workmanship in its construction.

It is a three-circuit tuner, with a detector and three stages of audio frequen-

cy amplification. A novel and "nifty" scheme for improving the results obtained from a short-wave regenerator of the type using variometers for both grid and plate tuning is the use of a four-circuit, three-position, anti-capacity switch mounted on the rear of each variometer. These switches perform the following feats: When thrown to one side, (left) they connect the rotor and stator coils of each variometer, in parallel, giving a wave-length range of 100 to 295 meters, with better control and better signal strength than normal, because losses are less, resistance less, and the full 180-degree rotation available, over amateur waves only. Thrown upright, these switches connect the windings of each variometer, in series as usual, with a range of 180 to 500 meters; and when switches are thrown to the other side (right), they connect the variometer windings, in series, and in addition switch small condensers in parallel across them, giving a wave-length range of 435 to 1,400 meters.

(A set of this type now makes an ideal receiver for amateur stations, besides getting down to the very short waves now under development, and still permitting the reception of all B.C. stations, and commercial and naval wave-lengths.)

THE ANTENNA SYSTEM

The aerial is a vertical, slanting, flat-top, inverted "L" type. It consists of six wires, spaced 3′ apart, 75′ long, 35′ and 80′ high. The high-end spreader is of one-inch iron pipe, each wire being soldered to this. The bridal is of heavy rope, with 10″ Electros insulators. The lead-in is taken from the low end and is a 10″ cage, running directly to the lead-in insulator into the operating room. The low-end spreader is of wood, each wire being insulated by a large porcelain ball insulator. The bridal at this end is also of rope, with large insulators, and is fastened to the peak of the house.

The 80′ pole is a home-made built-up affair, having been constructed by the operators of the station. 14 guy wires, well broken with insulators, support the pole, which has stood during two winters of severe storms without any damage.

The ground system consists of the water-mains, all connected with heavy soldered jumpers. A well, in which was sunk a long length of tin, besides well pipe, a cistern, in which was put over 50 lbs. of salt, strips of roofing-tin, 1′ wide and 4′ apart, run directly underneath the aerial. Each ground-lead is of 1″ copper ribbon, running directly to and tuned separately on the secondary of the oscillation transformer. A tuned counter-poise is also used, which consists of two wires, starting from the station, running 150′ back. These wires run 60′ past the end of the aerial, and are 60′ apart at the far end, where they are connected. The counterpoise gives a much higher radiation than the ground system. Tuned with the ground system, an increase of approximately 1¾ amperes is noted.

The natural wave-length period of the antenna is approximately 169 meters.

F. B. Ostman, of this station, has been actively engaged in amateur radio work since 1910, serving in radio work in the United States during the late war, with the artillery.

W. H. Ostman and Prescott Smith have been interested in amateur radio since 1920, directly after the war, when amateur transmission was again permitted.

Station 2OM has always been considered as a spark station, but claims credit for having done pioneer work in continuous-wave telegraphy as early as November, 1920, when a C.W. transmitter, using two 5-watt U.V.-202 tubes, was reported

Not an adaptation of old methods of current control but distinctly designed to utilize the great tuning possibilities of the vacuum tube itself.

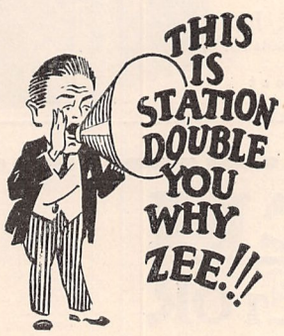
he Filame nt Control *of Infinite Adjustment*

FIL-KO-STAT

enables you to hear stations you've never heard before—

Your receiving set is probably bringing in stations you never hear! You just get that faint mouse-like whistle. But you can't bring in the music because your rheostat does not properly control your filament action.

Then again, you hear stations that sound as though they were down a deep well. They come in weak and indistinct. Your tuning apparatus gets the wave length, but your wire rheostat or other so-called filament control *can't* do the rest of the job which is to adjust the electronic flow in the vacuum tube to meet the conditions under which the station is operating.



With the Fil-Ko-Stat you bring in the weak stations strong and clear.

The Fil-Ko-Stat permits you to select other stations on similar wave lengths, tune one in and the other out with a slight turn of the knob without otherwise changing any of the tuning units.

The Fil-Ko-Stat cuts out "frying." It is non-microphonic and operates silently.

The Fil-Ko-Stat regulates filament heat and gives absolute control of electronic flow, permitting the finest tuning possible. Its fine adjustment starts where the tube begins to function.

The Fil-Ko-Stat's perfect and gradual increase of filament heat insures longer life to your tubes.

The Fil-Ko-Stat is the only instrument which permits that accurate control of "A" battery current necessary in using UV 199's and other dry cell tubes.

By Test the Best

Laboratory tests prove the Fil-Ko-Stat to have a fine adjustment area (which means ability to control filament heat and electronic flow) eighteen times greater than that of the wire rheostat and several times that of the next best filament control.

For All Tubes

The Fil-Ko-Stat is regulated at the factory to the ideal "off" point for all tubes, obviating the necessity of tampering with any screws or adjustments. And the "off" position is definite. When filament extinguishes the "A" Battery is positively disconnected.

No Discs to Break

Nothing to chip. Resistance element so finely divided further division is impossible.

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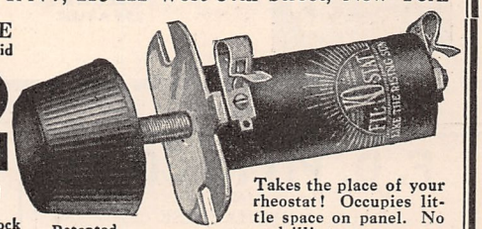

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Takes the place of your rheostat! Occupies little space on panel. No redrilling necessary.

GUARANTEED by the maker that it will be replaced if broken within one year.

Manufactured by DX INSTRUMENT CO. HARRISBURG PA.

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ACTUATING COILS

METRO HEADPHONES are supremely sensitive, matched in tone and uniformly efficient, largely because of the precise winding of the actuating coils which energize the magnets. Each coil wound with one unbroken length of thin-as-hair wire. Specially designed, extremely accurate winding machine insures uniform tension of wire, entirely eliminating the possibility of short-circuited turns. Only highest grade of pure, enameled copper wire used. Insist on Metro Headphones and be sure of quality.

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Little Giant Receiving Set—A surprisingly compact set. Simplest tuning device. Complete with Metro Headphones..... $14.00

Metro Wave Selector—Makes any set highly selective. Completely separates 360 from 400 meters $7.50

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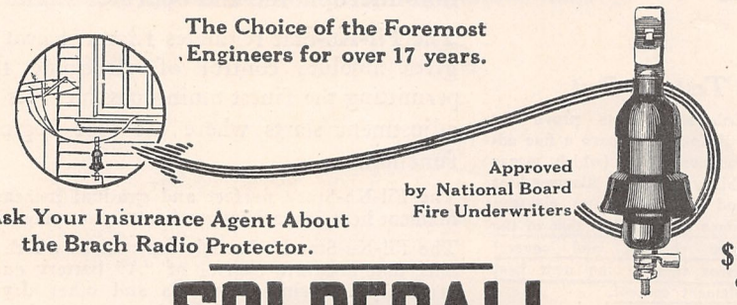
The Choice of the Foremost Engineers for over 17 years.



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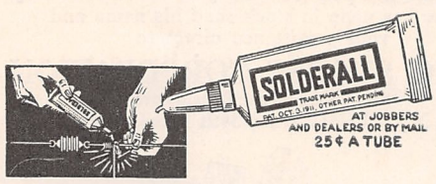

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W. T. 501 DETECTOR TUBE

$2 For tube sets, or to convert crystal sets into tube sets at small cost. Special socket 40c extra. Special adaptor 75c extra.

RADIO RESEARCH GUILD
40 Clinton Street Newark, N. J.

in all districts but the 6th in one month's operation, and two-way communication carried on with every district but the 6th and 7th.

Health by Radio

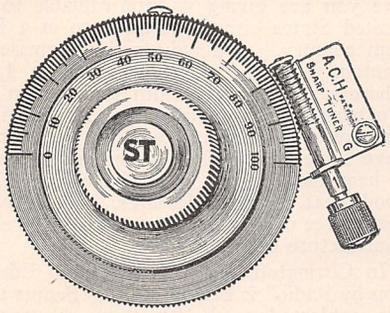
(*Continued from page* 10)

December 16, 1921, the initial attempt of spreading popular health education by means of radio telephony was made in July of that year. Only once prior to that time had this vehicle of intelligence been employed for purposes of radiating health education. Surgeon General Hugh S. Cumming, formally inaugurated "Public Health by Radio" on December 16, 1921, the wireless signals being transmitted from NOF, the Naval Aircraft Radio Laboratory, at Anacostia, District of Columbia. Only recently was this service, together with other Government broadcasts, transferred to NAA.

The *Seattle Post-Intelligencer* of Seattle, Washington, was the first commercial enterprise to file application for the privilege of re-broadcasting health information, this newspaper sending a telegram to the Public Health Service the following day after the initial lecture was broadcast from Washington. Thus was instituted a direct-by-mail-service between this Government health bureau and commercial concerns desirous of re-broadcasting its talks on how to keep well. Subsequently, eight other commercial broadcasting stations made applications for copies of these health hints to be forwarded by mail for dissemination from their respective wireless stations. These have maintained the service since that time without interruption, they being: The *La Presse,* a French daily newspaper at Montreal, Canada, operating station CKAC, health bulletins being broadcast in both English and French languages; WGI, the transmitting station of the American Radio and Research Corporation at Medford Hillside, Massachusetts; KDKA, the broadcasting station of the Westinghouse Electric and Manufacturing Company, at East Pittsburgh; WSAB, the broadcasting station operated by the Southeast Missouri State Teachers College, at Cape Girardeau, Missouri; WWJ, transmitting station operated by the *Detroit News,* at Detroit, Michigan; KGG, broadcasting station of the Hallock and Watson Radio Service, at Portland, Oregan; and WHN, located at Ridgewood, Long Island, covering the metropolitan district of New York. WDPA, the broadcasting station operated by the Chicago Board of Trade, is the first among the new prospective list of 50 commercial stations to inaugurate the service "Health Education by Radio."

Copies of the broadcasts of the Public Health Service are mailed to the coöperating commercial enterprises twice during the week, on Wednesday and Saturday. These consist of mimeographed sheets, varying in length from five to seven pages, and to impinge the words upon the carbon disk of the microphone usually requires about 15 minutes. That is, each lecture is put into the air within that period of time. Already, in excess of 140 of these broadcasts have been placed into circulation, consisting of more than one-half of a million words, whose combined auditors and readers numbered approximately 27,000,000 persons. The subjects treated range from a discourse on feet as a health asset to warnings of how to prevent such diseases as smallpox, typhoid fever, influenza, diphtheria, malaria, whooping cough, mumps, chickenpox, etc. "How Do You Sleep?" is the title of the most popular of the 140 lectures thus far delivered by means of radio telephony. Essentially, this warning is to the effect that if you are unable to sleep, suffering from insomia, there

USE A C H SHARP TUNER DIALS



I Am Fine for Summer Tuning
Why I Am Different

Not 5 to 1 or 50 to 1.

The A C H is 156 to 1 on 3" size, and 215 to 1 on 4" size.

Positive movement, no friction to slip, and no back lash in the spiral machine cut worm gear. (NOT MOULDED.)

Your Choice of

Rough tuning with dial or one thousandth of an inch in either direction with the Sharp Tuner Knob. Both controlled by center Knob ST.

Eliminates a vernier condenser. Locks instrument automatically. Dial grounded, reducing body capacity.

Money Back Guarantee

Price ACH 3" Dial complete..... $2.50
Price ACH 4" Dial complete..... 5.00
With ACH Condenser, extra..... 1.50

Regular fitting 5/16" hole, 1/4" and 3/16". Bushings, 5c. each extra. 10c. for all.

Free Plan with mail orders on request.

A. C. HAYDEN
RADIO & RESEARCH CO.
BROCKTON, MASS., U. S. A.

Mail Orders sent prepaid in U. S. A.

is trouble brewing. It is time to consult a physician. "How Does Your Baby Sleep?" is the title of another broadcast in this series. "Germs in Captivity," "Alone in a Big World—Leprosy," "What the Farmer Can Do to Prevent Malaria," "Foreign Bodies," "The Safe Vacation," "Cosmetics as Drugs," and "How to Reduce Your Weight," are among some of the alluring titles of subjects broadcast by the radio telephone.

The Public Health Service, to quote its own words, "is using radio because it believes that for the dissemination of educational information the use of all legitimate mediums that will be effective is desirable; and, second, if the best results are to be obtained the medium that promises the most direct and powerful effect upon the health habits of the population is most useful." In other words, the magic of the radio telephone is but another way of "sugar-coating pills" for consumption. When information is put into the air even unpleasant truths may be received and applied as wholesome by persons at the receiving ends of the wireless apparatus. For instance, in two counties in California one broadcast of the Public Health Service was circulated in every public school. A resident of Fairmont, West Virginia, writes that a school teacher takes down the health talks in shorthand for the purpose of using it in the school. A trainer of Boy Scouts copies the "Public Health by Radio" for a similar purpose. The *Detroit News* broadcasts the lecture and publishes it in the next morning's issue. One newspaper conducts a medical column based on the "Public Health Information by Radio Service."

At Kelseyville, California, the citizens of the community met in the schoolhouse and by use of a loud-speaking device "listened-in" upon the information relating to the physical welfare broadcast from a wireless transmitting station in Portland, Oregon. An electrical engineer, identified with a

Stromberg-Carlson
RADIO HEAD SETS

are preferred by ladies—the adjustment rod telescopes so it will not catch in hair or net.

There are other reasons why Stromberg-Carlson Head Sets are preferred not only by ladies, but by all critical users—

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The ear caps cover the ears—excluding outside noises.

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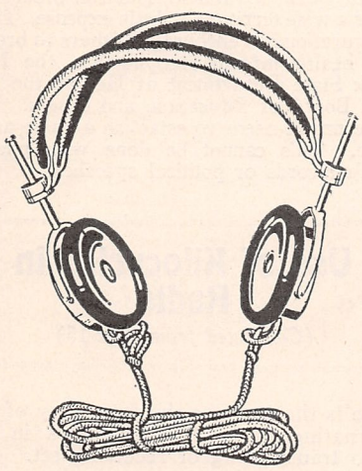

Federal Standard Head Sets are made with 2200 Ohms and 3200 Ohms resistance.

Federal makes a complete line of Standard Radio apparatus—all reasonably priced. Write for latest catalog.

Get a
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HEAD SET
for every member of the family

ADD to the pleasure you get out of Radio by permitting all the members of your family to enjoy it at once.

Family tastes are apt to be similar, which means that when a family favorite is being played or sung, everybody wishes to listen at once. They can hear clearly and distinctly when all the little ones (and the grown-ups, too) have an individual Federal Head Set. The pleasure of each individual will be enhanced by the pleasure of the family as a whole.

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Scientific winding and the expert hand-workmanship of master craftsmen give exceptional range and power.

Get these guaranteed head sets from your dealer today and refuse to accept a substitute.

Federal Telephone and Telegraph Company
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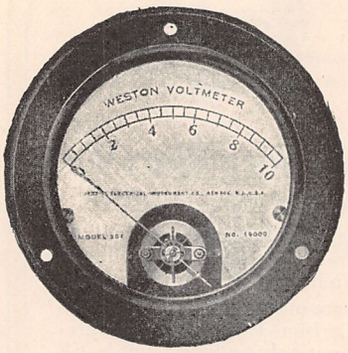

Weston Filament Voltmeter

Booklet J, and other Radio literature describes and illustrates these various Weston Instruments. Everyone interested in Radio should have this important data. Write for it today.

Why Blame STATIC?

Weak "B" batteries cause noises which are generally mistaken for static.

There is only one sure way of knowing just when it is static and when it is the "B" batteries —test them.

The manufacturers of "B" batteries recommend the discarding of 22½ volt batteries when they drop below 17 volts and 45 volt batteries when they reach 34 volts—for they then cause noise.

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Plus 20c postage—Total, $4.18
Send 10c in Stamps for Radio Catalog.
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sugar manufacturing company in Cuba, writes: "Here we are away from good medical service and any constant education like you are giving is sure valuable to us United States citizens down here in a foreign country." An industrial enterprise in Canton, North Carolina, employing 1,000 laborers, is receiving health information for the benefit of its employees. A citizen of Brentwood, Maryland, writes: "I always have some of my friends and neighbors in to hear the lectures. They have benefited a good deal by your lectures. There have been three or four children vaccinated since your lecture on that subject."

In Covington, Kentucky, "Health Education by Radio" is helpful to Boy Scouts that are subjected to health tests. A person writing from Nashua, New Hampshire, says, "A week or so ago I had three of our noted doctors at my house at the time that you were talking on tonsils and adenoids." A citizen of Dubuque, Iowa, says that health lectures are of particular interest to his mother who is connected with a children's clinic. In McGregor, Iowa, hints on how to keep fit physically are heard in a hall accommodating 100 persons, a loud-speaking horn being employed. "What better way could the Government educate the people in the way to better health and to help prevent the spread of disease in the United States?" inquires one individual. A teacher in Kalamazoo, Michigan, states that these lectures help her in properly instructing the pupils of the school in which she teaches. A person residing in Cherrydale, Virginia, was impressed with the advice that bottles of medicine prescribed for a patient should be destroyed after the recovery of the subject. A man in Brockton, Massachusetts, was so much impressed with the discourse, "How Do You Sleep?" that he has asked for a repetition of it by radio telephony. A woman of Brookfield, Massachusetts, who is a constant sufferer from headache, received valuable hints from a talk by radio telephone on this subject. A chief train dispatcher, living in Providence, Rhode Island, writes: "I had my eyes tested this morning and found my glasses needed changing and got a new prescription." A meteorologist of Binghamton, N. Y., states: "All public health work is valuable and the broadcasts cover a wide territory at little expense. Their inauguration has encouraged others to broadcast health information, notably, the New York State Department of Health, the Detroit Board of Education, and others. The Government needs to establish a radio audience. This cannot be done with phonograph records or political speeches."

Use of Kilocycles in Radio

(*Continued from page* 15)

wave is the same as the frequency of the alternating current which flows in the radio transmitting or receiving set.

As often happens in technical matters, the idea of "kilocycles" is simpler than the forbidding aspect of the word suggests. "Kilo" means a thousand, and "cycle" means one complete alternation. The number of kilocycles indicates the number of thousands of times that the rapidly alternating current repeats its flow in either direction in the antenna in one second. The smaller the wave-length in meters, the larger is the frequency in kilocycles.

The reason that kilocycles are coming into use and displacing meters is that the necessary separation of the frequency of transmitting stations to prevent interference is the same, no matter what the fre-

quency may be. This necessary separation is variable and quite misleading when expressed in meters. Thus the number of radio messages that can be transmitted simultaneously without interference can be correctly judged from the kilocycles but not from the meters. For example, the amateurs will in the future work in a band of wave-lengths from 150 to 200 meters, but this is a frequency band from 2000 to 1500 kilocycles. This is an enormously wider band when considered from the viewpoint of kilocycles than, for example, the band having the same width in meters from 1000 to 1050 meters, which is 300 to 286 kilocycles. While it is possible to carry on fifty simultaneous radio telephone communications between 150 and 200 meters, only one could be carried on between 1000 and 1050 meters.

In accordance with the recommendation of the Second National Radio Conference, the Department of Commerce and other Government departments will hereafter follow the practice of specifying in even values of kilocycles rather than meters. The Conference recommended the practice of expressing wave frequency in kilocycles per second with wave-length in meters in parentheses thereafter. The relation between the two is very simple. To obtain kilocycles, divide 300,000 by the number of meters; to obtain meters, divide 300,000 by the number of kilocycles. For example, 100 meters = approximately 3000 kilocycles, 300 meters = 1000 kilocycles, 1000 meters = 300 kilocycles, 3000 meters = 100 kilocycles.

For highly accurate conversion the factor 299,820 should be used instead of 300,000.

WANTED, A NAME

Someone has suggested the name of "Radiowners" for those of us who have sets and listen in. Certainly it is better than most of the awkward terms in use today. "Listeners-in" is too long, "Radiophans" or "Radiofans" sounds like the name of an instrument, and we could hardly designate them as "receivers."

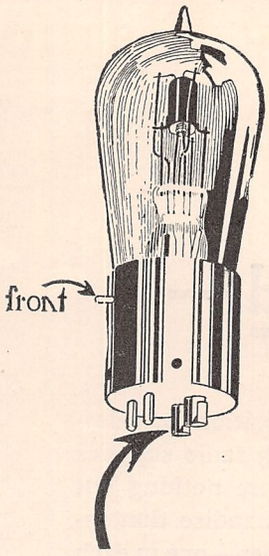
Calls Heard

(*Continued from page* 41)

3II, 3BVY, 3BNU, 3BIF, 3FB, 3OH, 3BOF, 3ADB, 3CTY, 3ZP, 3BHL, 3KM, 3GZ, 3CC, 3AFW, 3AMW, 3AOD, 3AUW, 3SU, 3ARO, 3APR, 3CBZ, 3BJY, 3VW, 4BW, 4BI, 4BK, 4BY, 4EB, 4EP, 4EL, 4NV, 4FT, 4BX, 4OI, 4XO, 4FS, 4AAE, 4AG, 4MB, 5XB, 5XAJ, 5EK, 5BA, 5KC, 5XT, 5MB, 5ZB, 5JB, 5NZ, 5AAG, 5ZH, 5XAD, 5BH, 7ZO, 7ZV, 8CLV, 8EEC, 8XI, 8RJ, 8VN, 8AMM, 8VQ, 8BFX, 8JY, 8BNG, 8CIM, 8CUV, 8ZD, 8ABX, 8CFN, 8BV, 8UC, 8EL, 8CEA, 8CF, 8LO, 8ARD, 8WX, 8ALF, 8BDA, 8CDI, 8KJ, 8LC, 8EO, 8ZO, 8BDU, 8CXF, 8XY, 8ADQ, 8AIK, 8QK, 8BEO, 8FV, 8AWZ, 8CDD, 8CRL, 8CKO, 8ANB, 8AIW, 8CIY, 8BVY, 8ON, 8CLD, 8AVD, 8BJO, 8DBS, 8TE, 8ALT, 8BEN, 8AJX, 8UF, 8CBC, 8KP, 8GZ, 8ZW, 8CPV, 8FU, 8AXA, 8JY, 8ZK, 8BXA, 8II, 8BBE, 8JJ, 9ATO, 9ANQ, 9CDU, 9CTE, 9AWF, 9DCB, 9ZN, 9AJ, 9BCH, 9DRR, 9APW, 9APS, 9DKK, 9CP, 9ACE, 9ZAA, 9BHD, 9CYM, 9OK, 9AWK, 9DRI, 9ZAE, 9DGO, 9BBD, 9CBA, 9EI, 9BVY, 9DGV, 9AAP, 9BGI, 9HK, 9QF, 9CMV, 9RY, 9BDB, 9DKL, 9FP, 9VZ, 9CY, 9BRE, 9ZY, 9BAR, 9DBL, 9AEN, 9BZI, 9YB, 9AEC, 9DXE, 9IL, 9CN, 9EJT, 9BRK, 9DQM, 9DAX, 9DWQ, 9AMI, 9CPG, 9AVG, 9UU, 9ZT, 9PQ, 9CUI, 9QR, 9DWF, 9AZX, 9BHW, 9BXK, 9OX, 9ARG, 9AZE, 9CXP, 9BGB, 9AL, 9CTV, 9AJX, 9AJS, 9APD, 9LZ, 9DYW, 9AEY, 9DSD, 9BDS, 9BUC, 9DC, 9DFB.

3WU, WASHINGTON, D. C. (ONE TUBE)

C. W.—1AP, 1AW, 1BM, 1FD, 1GV, 1II, 1IV, 1MY, 1ON, 1OW, 1PM, 1QP, 1RD, 1RU, 1UN, 1XM, 1XX, 1XZ, 1ZE, 1ABF, 1AGH, 1AGP, 1AIJ, 1AKL, 1AOK, 1AOL, 1ARY, 1ASF, 1AUN, 1AWB, 1AYQ, 1AYZ, 1BAS, 1BDI, 1BDQ, 1BEP, 1BGF, 1BKA, 1BKQ, 1BMR, 1BOQ, 1BYN, 2EL, 2FZ, 2OM, 2RM, 2AFP, 2AWF, 2BBB, 2BJP, 2BMR, 2BRB, 2BRC, 2BUR, 2BYW, 2CCD, 2CPD, 2CSL, 2CVU, 2CXD, 3's too numerous, 4BX, 4BY, 4EA, 4EL, 4FT, 4JK, 4KC, 4NV, 4OI, 5FT, 5FV, 5KC,



Different tubes require different capacity fuses. When ordering state exactly what tube fuses are for.

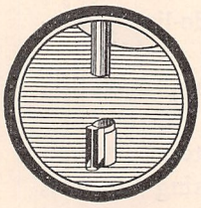
"Here! Take It!"

—that's what you say to fickle chance the moment you "turn on" your tube unprotected by the

RADECO SAFETY FUSE

(Patent Pending)

the ONLY safety device that affords absolute protection against "blowing out" a filament.



Fitting directly on the filament terminals of the tube itself the Radeco Fuse makes it just impossible for excess current, even by accident to "burn out" the tube.

It is attached in a second; fits any standard tube used in any standard socket, and positively does not affect the efficiency of your set.

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Do not force fuse on filament terminals. If contact solder is rough, file or sandpaper down so that fuse slips on easily. Filament terminals are the two farthest from the locking projection on base of tube.

For UV 199, WD 11, WD 12, 201A . . . 50c each

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In standard packages

Buy at your dealers or by mail

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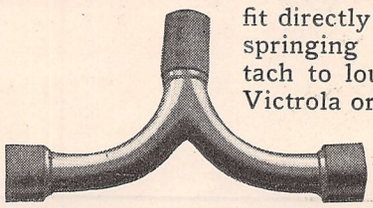

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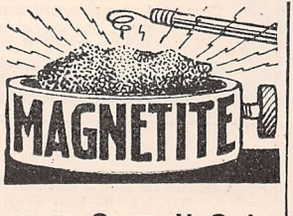

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QRK mi 10-watt C. W.? Wl QSL all cards.

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Canadian—2AN, 3BP, 3GK, 3GL, 3JL, 3XM, 9AL, 9BJ.

8CBB, KITTANNING, PA.

Spark—4GN, 5TO, 5ZR, 8AIB, 8AIZ, 8AWP.

C. W.—8AFF, 8ABE, 8AFW, 8AHR, 8AIG, 8AIO, 8QIW, 8AVT, 8AWU, 8BDB, 8BUM, 8BUT, 8SB, 8UE, 8ZZ.

Phone—5AC, 8BDD, 8BRC, 8XJ, 8XY.

C. E. CORNWELL, OSAGE, IOWA (1 TUBE)

1GV, 1MY, 1RV, 1AOK, 1APC, 1BES, 1BRQ, 2GI, 2LT, 2SG, 2WC, 2XZ, 2ZP, 2ARI, 2ARO, 2ASI, 2AYV, 2AWL, 2BGH, 2BMR, 2CCD, 3BV, 3CA, 3FQ, 3GZ, 3JJ, 3KM, 3MF, 3OH, 3OT, 3PZ, 3TJ, 3UH, 3WF, 3XM, 3AFB, 3ALN, 3ARO, 3BOB, 3BSU, 3BVC, 4BI, 4BX, 4BY, 4CD, 4EA, 4EB, 4EH, 4FT, 4FK, 4GZ, 4HW, 4JC, 4JK, 4JL, 4KC, 4KL, 4MB, 4NV, 4OH, 4PD, 4YA, 4YD, too many 5's, 6BJG, 6VM, 6ZA, 6ZH, 6ZZ, 7PF, 7ZU, 7ZV, too many 8's and 9's.

Canadian—3BP, 3BV, 3DH, 3FO, 3GB, 3GK, 3JL, 3NI, 4BV, 9BJ, 9BX.

8CFQ, LAKE ODESSA, MICH.

C. W.—1XM, 2FP, 3ZO, 4GL, 5XV, 6EB, 6ZZ, 6BOB, 7ZU, 8's and 9's too numerous.

Spark—1BOQ, 1CNI, 1CKP, (1CKS), (2BK), 2FP, (2JZ), (2CJX), (3CS), (3IY), (3QW), (3ACN), (3API), (4EG), 4FD, 4GN, (4MV), (5DH), 5RB, 5TA, 5XA, (5XAC), 5ZAS, (8EB), (8TC), (8TH), (8VQ), (8AEO), (8AIB), (8AWP, phone and ICW), (8BBY), (8BDA), (8BFY), (8BNC), (8BPG), (8BYO), (8CEJ), (8CPM), (8CTD), (8CVD), (8DCW), (8DFH), other 8's too numerous, (9AZ), (9CA), (9LF), (9NQ), (9VZ), 9AAW, 9ABM, (9ACN), (9AGG), (9AHQ), (9AJE), (9ALX), (9AMZ), (9ANP), (9AOJ), (9APK), 9APN, 9ASO, 9AZF, (9BAG), (9BDH), 9BOF, 9BPN, 9BTX, (9BWJ), (9BWQ), (9CIC), 9DAG, (9DGW), (9DHZ), (9DMJ), (9DOT), 9DWP, (9EFC), (9EFQ), other 9's too numerous.

Canadian—(3FH), 3BG.

3CK, TORONTO, ONT.

C. W.—1AJX, 1API, 1AYT, 1BAQ, 1BHR, 1BKQ, 1BNF, 1BOQ, 1BQI, 1BQK, 1BRQ, 1CAB, 1CAC, 1CBT, 1CDR, 1CFB, 1CPI, 1CPN, 1GS, 1MY, 1OK, 1ZE, 2APA, 2AUJ, 2BA, 2BUY,

(*Continued on page* 89)

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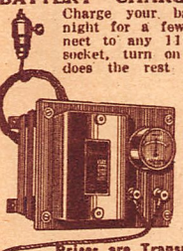
You can make real savings on these batteries. Don't pay more. We guarantee them to equal any on the market regardless of price. Absolutely uniform. Extra long life.

R180 Signal Corps type, small size, 15 cells, 22½ volts. Each....95c

R184 Variable Large Navy size, 6½x4x3 inches 5 taps, giving range from 16½ to 22½ volts in 1½ volt steps. Each.....$1.80

R188 Combination Tapped 45 volts 30 cell, 13x4x3 battery. Tapped to give 45, 22½, 21, 19½, 18 and 16½ volts. Handles both detector and amplifier tubes. Each.....$3.55

HOMECHARGER BATTERY CHARGING RECTIFIER

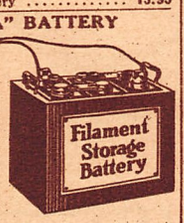


Charge your battery at home over night for a few cents. Simply connect to any 110 volt 60 cycle light socket, turn on current and rectifier does the rest automatically. Will work for years without attention. Simple connections. Gives a tapering charge which batteries should have. You can make it pay a profit charging your friends' auto batteries. Long connecting cords with pair of battery clips.

Prices are Transportation Paid.

R201 For 6 volt battery $13.95
R203 For 12 volt battery 13.95

STORAGE "A" BATTERY



A very high grade battery made especially for radio service. Guaranteed for three years. Properly cared for will give many more years of service for filament lighting. Made of best new materials. Full capacity. The best battery buy on the market. Try one of these batteries on your set for 10 days. If at the end of that time you are not fully satisfied with the battery return it and we will refund the purchase price.

R194 6 volt, 40 ampere size. Each....$10.00
R196 6 volt, 80 ampere size. Each.... 12.50

VACUUM TUBES

Standard Brands—Cunningham Radiotron. Every one guaranteed new and perfect. We will ship brand in stock unless you specify otherwise.

R105 Detector, UV200 C300 Ea. $4.30
R112 Amplifier, UV201A C301A 5.95
R118 5 Watt Transmitter..... 7.70
R107 WD11 1¼ v. Fil. Each.....$5.95
R101 WD12 Each..... 5.95
R102 UV199. Each..... 5.95
R103 UV199 Socket 59c
R104 UV199 Adapter 49c
R108 WD11 Socket. Each..... 49c
R109 WD11 Adapter. Each..... 48c

FILAMENT CONTROL RHEOSTATS

Best grade. High heat resisting base. Diam. 2¼ in. cap 1½ amp. Resist. 6 ohms. 1¼ in. knob with pointer. 75c value.

R132 Each 45c

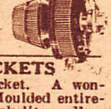
R131—25 Ohm Rheostat for 301A 201A tubes 69c

POTENTIOMETER

Same style as above rheostat. Gives fine "B" battery adjustment. Resistance 140 ohms.

R133 Each 89c

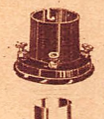
VERNIER RHEOSTAT



Gives exceedingly fine control of "A" battery current. A necessity for best receiving results.

R135 Each 89c

VACUUM TUBE SOCKETS



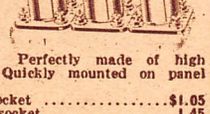
Our Special Socket. A wonderful value. Moulded entirely of brown bakelite. Four binding post connections. Right angled contact springs.

R140 Each 39c

High Grade combination type for panel or table mounting. Metal tube. High insulation base. One of the best sockets made.

R146 Each 45c

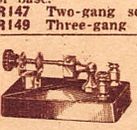
TWO AND THREE GANG SOCKETS



These sockets make it easy to build detector and amplifier units and make a neat, compact workmanlike job. Perfectly made of high grade materials. Quickly mounted on panel or base.

R147 Two-gang socket $1.05
R149 Three-gang socket 1.45

GALENA DETECTOR



Easy fine adjustment. Crystal mounted in cup. Moulded base and knob. Brass parts polished nickel finish. An unequaled value.

R732 Each 59c

DETECTOR CRYSTALS CAREFULLY TESTED

R736 Galena, Arlington tested, per piece. 19c
R738 Silicon, Arlington tested, per piece. 19c
R735 Tested, Galena, per piece..... 9c
R737 Tested, Silicon, per piece..... 9c

WE PAY TRANSPORTATION CHARGES EAST OF THE ROCKIES

THE PRICES QUOTED DELIVER THE GOODS TO YOUR DOOR

FAST SERVICE—TRY US AND BE CONVINCED

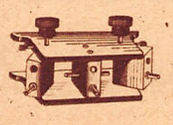
THIS GUARANTEE PROTECTS YOU—Examine the goods we ship you. They must suit you in every respect.. If you are not satisfied with your purchase return the goods at once and we will refund the price you paid.

"HONEYCOMB" COILS

Carefully made—fine looking coils. Highest efficiency. Low distributed capacity effect, low resistance—high self inductance. Very firm impregnation. Range given is in meters when varied with .001 variable condenser. Mounted coils have standard plug mountings.

Turns	Range	Art No.	Not Mntd.	Art No.	Price Mntd.
25	120- 250	R301	$0.39	R320	$0.89
35	175- 450	R302	.42	R322	.95
50	240- 720	R303	.49	R323	1.04
75	390- 910	R304	.54	R324	1.08
100	500- 1450	R305	.58	R325	1.13
150	600- 2000	R306	.63	R326	1.17
200	900- 2500	R307	.72	R327	1.26
250	1200- 3500	R308	.78	R328	1.35
300	1500- 4500	R309	.82	R329	1.36
400	2000- 5000	R310	.97	R330	1.57
500	2800- 6100	R311	1.12	R331	1.63
600	4000-10000	R312	1.27	R332	1.78
750	5000-12000	R313	1.43	R333	1.93
1000	7900-15000	R314	1.70	R334	2.28
1250	9750-19500	R315	1.92	R335	2 49
1500	14500-26500	R316	2.18	R336	2.65

COIL MOUNTINGS

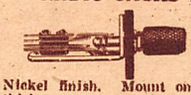


R340 Three-coil mounting $3.95

R341 Two-coil mounting $2.95

High grade fine looking mountings. Polished black composition. Center receptacle stationary, two outer ones adjusted by knobs. Takes any standard mounted coil.

RADIO JACKS AND PLUGS



Finest grade jacks. Improved design. Best materials. Phosphor bronze springs. Silver contact points. Nickel finish. Mount on panels ⅛ to ⅜ in. thick.

Jacks Only:
R390 Open circuit. Each.....43c
R391 Closed circuit. Each.....49c
R392 Two circuit. Each.....60c
R393 Single circuit filament cont. 69c
R394 Two circuit filament cont. 85c

R395 Plug. Large space with set screws for attaching cord. Each.....49c

BINDING POSTS

Brass, polished nickel finish. Washer and 6-32 in. screw extending ⅜ in.

R370 Large size—barrel and knob ¾ in. long, dozen..85c

R372 Smaller size — barrel and knob 9-16 in. long, dozen.....70c

R374 Large size with composition knob, dozen....50c

R376 Large size with hole for phone tip or wire, dozen.....80c

R378 Small size with hole for phone tip or wire, dozen.....35c

SWITCH CONTACT POINTS

Brass polished nickel finish. All have ⅜ in. long size 6-32 screws and two nuts. All prices the same.

Dozen 18c Hundred $1.05

Order by Article Number.

R360 Head, ¼ in.; Diam. ¼ in. High
R362 Head, 3-16 in.; Diam. ⅛ in. High
R363 Head, 3-16 in.; Diam. 1-16 in. High

SWITCH LEVERS

Moulded composition knob. Exposed metal parts polished nickel finish. Fitted with panel bushing, spring and two set nuts. A high grade switch.

R382 1½ in. Radius
R381 1¼ in. Radius } 19c Ea.
R380 1 in. Radius

SWITCH LEVER STOP

Brass, polished nickel finish.

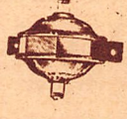
R386—Dozen 18c. Hundred $1.05

ONE-PIECE DIAL AND KNOB

Moulded in one piece of polished black composition with clean plain engraved scale and numerals in contrasting white enamel. Ribbed knob to fit the hand. An attractive neat pattern.

R900 2 in Diam. for 3-16 in. shaft. Ea. 19c
R901 2 in. Diam. for ¼ in. shaft. Ea...19c
R904 3 in. Diam. for 3-16 in. shaft. Ea...25c
R905 3 in. Diam. for ¼ in. shaft. Ea...25c
R906 3½ in. Diam. for 3-16 in. shaft. Ea 35c
R907 3½ in. Diam. for ¼ in. shaft. Ea 35c

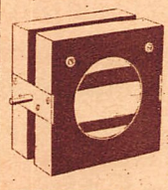
OUTDOOR LIGHTNING ARRESTER



R980 Price $1.58

Protect your instruments with this lightning arrester. You cannot afford not to. Weatherproof porcelain case. Air gap type. Permanent. Durable. The most practical quality arrester obtainable. Underwriters approved.

VARIOMETER

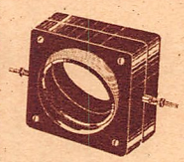


R410—Completely assembled, price $2.69

Perfect in design and construction. Accurate wood forms of genuine solid mahogany. Correct inductive ratios. Solid baked windings. Positive contacts. Highest efficiency. A real bargain.

R411—Not assembled nor wound but all parts complete except wire, including winding form. $1.48

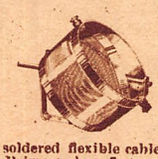
MOULDED VARIOMETER



Polished black moulded rotor and stator forms. Maximum inductance with greatest efficiency and minimum distributed capacity. A high grade durable instrument that will make up into a set you will be proud of and will get the best results. Wave length 180 to 600 meters. 3¼ in. square, 1⅞ in. thick.

R412 Price including mounting brackets $3.48

IMPROVED 180° VARIO-COUPLER



R418 Price $2.89

Our price shows you a big saving. An instrument of highest quality. The most efficient type of coupler. Insures sharper tuning and louder signals. Primary and secondary wound on genuine bakelite tubes. Secondary connections through soldered flexible cables eliminates contact noises. Primary has 7 taps. Can be panel or table mounted. Range 180 to 650 meters.

MAGNET WIRE

Insulated copper wire. Best quality even drawn wire, one piece to a spool. Prices quoted are for 8 oz. spools.

Double Cotton Covered		Enameled Insulation		Green Silk Covered	
Number R990		Number R992		Number R991	
Gauge	Price	Gauge	Price	Gauge	Price
18	50c	20	45c	20	$0.78
20	60c	22	55c	22	.90
22	75c	24	61c	24	1.05
24	85c	26	65c	26	1.18
26	95c	30	70c	30	1.70
28	$1.15	32	79c	32	2.05
30	1.65	36	98c	36	2.75

STRANDED ANTENNA WIRE

Cabled of fine copper strands. Very flexible. High tensile strength. Best for aerials.

R248—100 ft. coil 72c R249—500 ft. coil $3.20

SOLID BARE COPPER WIRE

Solid bare copper wire for aerials, leads or wiring instruments.

Solid Bare Copper Wire, size 14
R240—100 ft. coil 49c R242—500 ft. coil $2.35

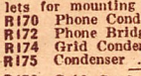
Solid Bare Copper Wire, size 12
R244—100 ft. coil 67c R245—500 ft. coil $3.05

ANTENNA INSULATORS

R260 Size 1x3¼. Two for 17c
R267 Size 2⅛x3¼. Two for 55c
R264 Size 1½x4. Two for 69c
R266 Size 1½x10½. Two for $1.28

R260 R262 R264-6

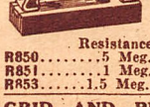
PHONE AND GRID CONDENSERS



A compact style of condenser that is very satisfactory. Conducting sheets and dielectric are wound on fiber strip with eyelets for mounting and connections. Each 12c

R170 Phone Condenser .001 Mfd.
R172 Phone Bridging Condenser .0005 Mfd.
R174 Grid Condenser .00025 Mfd.
R175 Condenser .006. Each.....25c
R176 Grid Condenser .00025 with pencil mark leak. Each.....24c

TUBULAR GRID LEAKS AND CONDENSERS—MOUNTED STYLE



Very convenient. Permits quick change of leaks or condensers of varying capacities.

Grid Leaks Each	Price 39c		
Resistance		Resistance	
R850 .5 Meg.		R855 2. Meg.	
R851 1 Meg.		R857 3. Meg.	
R853 1.5 Meg.		R859 5. Meg.	

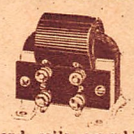
GRID AND PLATE CONDENSERS

Price, each 55c
R832 .0001 Mfd. For special circuits.
R834 .00025 Mfd. For U.V.201 and Cun. 301
R836 .0005 Mfd. For U.V.200 and Cun. 300

MOUNTINGS

Bakelite base. Spring clip contact.
R840 Single mounting. Each.....32c
R842 Double mounting. Each.....57c
R844 Triple mounting. Each.....76c

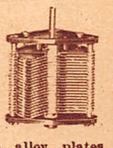
OUR SPECIAL AUDIO FREQUENCY AMPLIFYING TRANSFORMERS



As high as three stages can be used without howling due to proper impedence ratio, minimum distributed capacity, low core losses and proper insulation. Mounted style has bakelite panel with binding post connections. Unmounted has core and coils assembled with two holes in core for fastening to apparatus.

R234 10 to 1 Mounted. Each $3.48
R235 10 to 1 Unmounted. Each 2.95
R236 3 to 1 Mounted. Each 3.40
R237 3 to 1 Unmounted. Each 2.85

BARAWIK SPECIAL PANEL MOUNTING VARIABLE CONDENSERS



R812 43 plate .001 Mfd. $1.73
R813 21 plate .0005 Mfd. 1.43
R814 11 plate .00025 Mfd. 1.32
R815 3 plate Vernier ... .98

These are especially high grade condensers and we guarantee them to be mechanically and electrically perfect. Fine polished end plates of heavy bakelite. Shafts ¼ inch diameter. Sturdy, heavy aluminum alloy plates perfectly spaced to insure smooth, even reliable capacity. Our low prices save you money. These condensers are of the very best make and are not to be compared with many inferior cheap condensers offered. We guarantee them to please you or your money back.

COMBINATION VERNIER VARIABLE CONDENSERS

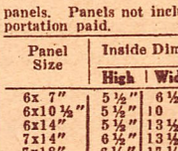
R824 23 plate .0005 Mfd. with dial and knobs. Price....$2.89
R826 43 plate .001 Mfd. with dial and knobs. Price....$3.45

The latest improvement in condensers consists of regular variable condenser controlled by large knob and dial mounted with a three plate vernier condenser, which is controlled by separate knob mounted above knob on dial. This arrangement permits of very fine tuning. Compact convenient mounting on panel. High grade design and construction. Finely finished.

STANDARD BRAND HEADSETS

R754 Baldwin Type C with universal jack plug $11.75
R755 Baldwin Type C unit with cord $5.50
R756 Red-Head, 3000 ohm 5.78
R768 Brandes, 2000 ohm 6.90
R770—2000 ohm Barawik 3.75
R751 Murdock 56, 2000 ohm 4.20
R752 Murdock 56, 3000 ohm 4.95
R764 Frost, 2000 ohm 4.20
R766 Frost, 3000 ohm $4.85
R758 Western Electric, 2200 ohm 9.50

CABINETS



Fine looking cabinets solidly built. Elegant hand rubbed finish. You will be proud of your set mounted in one of these cabinets. Hinged tops. Front rabbeted to take panels. Panels not included. Prices are transportation paid.

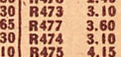
Panel Size	Inside Dimensions High	Wide	Deep	Art. No.	Price Each
6x 7"	5½"	6½"	7"	R420	$2.48
6x10½"	5½"	10 "	7"	R422	2.75
6x14"	5½"	13½"	7"	R424	3.30
7x14"	6½"	13½"	7"	R423	3.60
7x18"	6½"	17½"	7"	R426	3.90
7x21"	6½"	20½"	7"	R425	4.20
9x14"	8½"	13½"	10"	R428	3.70
12x14"	11½"	13½"	10"	R430	4.40
12x21"	11½"	20½"	10"	R432	5.25

RADIO "BAKELITE" PANELS

Notice our very low prices on this fine quality material. We supply genuine Bakelite, Condensite Celeron or Formica, all of which are materials with practically identical mechanical, chemical and electrical properties. Machines well without chipping. Won't warp. Waterproof. Highest mechanical and dielectric strength. Attractive natural polished black finish which can be sanded and oiled for extra fine work.

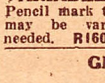
Panel Size Inches	⅛" thick Art No.	Price	3-16" thick Art No.	Price	¼" thick Art No.	Price
6x7	R450	$0.50	R460	$0.75	R470	$0.98
6x10½	R451	.75	R461	1.11	R470	1.47
6x14	R452	1.05	R462	1.55	R472	2.05
7x14	R458	1.20	R468	1.80	R478	2.40
7x18	R453	1.55	R463	2.30	R473	3.10
7x21	R457	1.78	R467	2.65	R477	3.60
9x14	R454	1.60	R464	2.30	R474	3.10
12x14	R455	2.10	R465	3.10	R475	4.15
12x21	R456	3.15	R466	4.65	R476	6.20

VARIABLE GRID LEAK



Pencil mark type. Resistance may be varied exactly as needed. R160 Each 19c

GRID CONDENSER

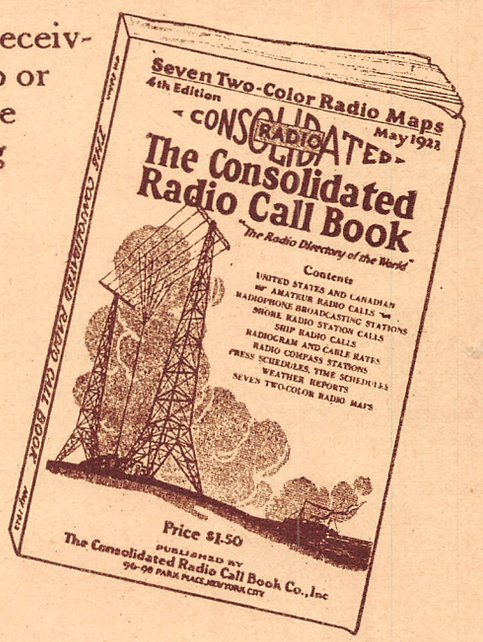


R162 Mounting holes spaced to fit lugs of above leak. Cap. .00025 MF. 14c

R163 Same as 162 but higher grade. Enclosed in metal case. 39c

KNOW WHO IS SENDING

Get twice the pleasure and usefulness out of your receiving set. Look up the name and location of any ship or land station whose messages you pick up—learn the name and address of that amateur whose sending set you just heard.



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Consolidated Radio Call Book

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7 Two-Color Radio Maps

Five of them are Continental Maps showing all stations throughout the world handling commercial traffic, with their calls; one showing the amateur radio districts of the United States and the principal radiophone broadcasting stations with their calls; and a map of the United States Weather Forecast Zones. Seven wonderful, two-color radio maps with a wealth of information that will give you a great deal of pleasure and knowledge.

Ninety-five per cent of all Amateur Calls in the United States and Canada are Listed

Also Contains a Wealth of Other Valuable Information

Amateur Radio Calls of the United States and Canada; Every Vessel, Coast Station, and Radio-Compass Station in the World; Radiophone Broadcasting Stations of the United States; Every High-Power Station in the World; Special Land Stations of the United States; Time Signals, Hydrographic and Weather Reports of the United States and Principal Foreign Countries; International Abbreviations; Assignment of International Calls; Press Schedules; Radiogram Rates; Cable Rates; International Morse Code and Continental Signals; and Complete General Information covering Distress Calls, International Safety Signal, Use of 800-Meter Wave Length, Amendments and Changes in Various Governmental Regulations, How to Determine Charges on Radiograms, Free Medical Advice by Radio to Vessels, and much other useful information.

$1.50 Prepaid

And every vessel and land station in the world is represented and listed alphabetically, according both as to name of vessel or land station, and to call letters. The Consolidated Radio Call Book is the only book in print officially listing all the Radio calls as issued by the Bureau of Commerce. And the New Radiophone Broadcast Section is particularly complete and gives all available information concerning calls, wave lengths, PROGRAMS, etc.

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CONSOLIDATED RADIO CALL BOOK CO., Inc.

233 FULTON STREET, NEW YORK CITY

NOW **$1.00**

ANNOUNCEMENT

NOW **$1.50**

SINCE we placed the NATIONAL AIRPHONE "GOLD-GRAIN" DETECTOR on the market, six months ago, it has taken the country by storm. Thousands upon thousands of radio fans, amateurs and experimenters are now using "GOLD-GRAIN" DETECTORS for Crystal outfits, for Reflex Sets and for many other radio purposes.

The demand for "GOLD-GRAIN" DETECTORS has been so tremendous that we have been enabled to effect vast economies in our manufacturing processes. This has made it possible for us to make sweeping price reductions in these detectors.

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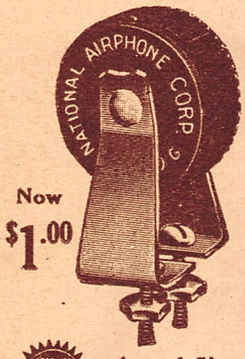

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This Detector is not a fixed Detector, but is foolproof; it has no catwhiskers, no springs, no balls, no adjusting handles; no fussing. The Detector is Entirely enclosed in hard rubber composition cartridge.

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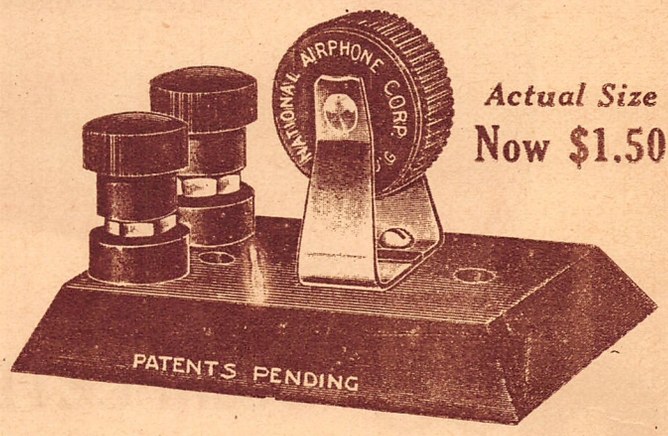

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Should any National "Gold-Grain" Detector not be in first-class condition when purchased and within 10 days you return it to us unopened, or in unbroken condition, we will repair it or send you a new one free of charge. **Order from your Dealer—or direct from us.**

HOW TO MAKE A REFLEX SET

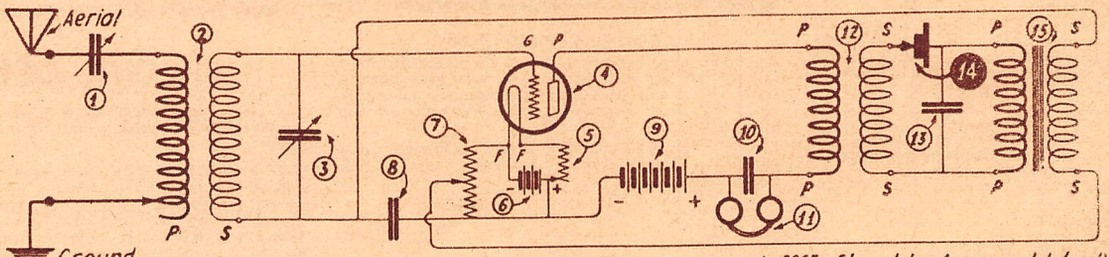
With the reflex circuits illustrated, and with the values as given, it is now possible, with a single tube and a NATIONAL AIRPHONE "GOLD-GRAIN" DETECTOR, to receive distances over 1500 miles on a small aerial.

The price of the parts as shown in the illustrations should not come higher than from $20.00 to $22.00 (excluding Vacuum tube and phones).

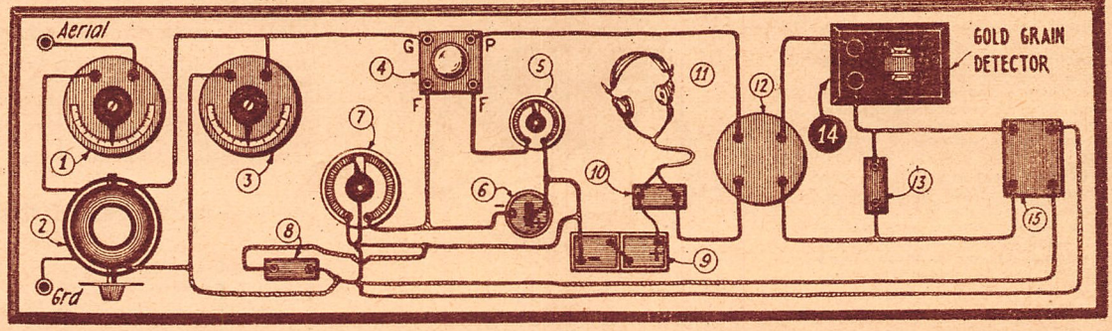
The results are really remarkable, and by using a WD-11 Tube it is not even necessary to use a storage battery. A small "B" Battery and a dry cell can be used.

An ideal portable outfit can be constructed quite readily with the Reflex, and for local stations, within a radius of 50 miles, an outdoor aerial is not required. A small two-foot loop may be used, and it becomes then possible to obtain a moderate volume of sound on a loud speaker.

The Reflex outfit as shown in the circuit herewith has been constructed by our engineering department and we shall be glad to demonstrate it to the radio fraternity. The extraordinary results obtained with this circuit are in part due to the NATIONAL AIRPHONE "GOLD-GRAIN" DETECTOR. Recent changes made in this Detector have improved it to such an extent that it is now entirely automatic and will stay put with an occasional adjustment.



1= var. cond. 001 mfd.-43 plates. 2= variocoupler... 3= var. cond. .0005 mfd. 23 plates. 4= vacuum tube (amp.)
14=NATIONAL AIRPHONE GOLD GRAIN DETECTOR 5= rheostat..6 "A" batt. (DRY CELL FOR WD-11) 7=200-400 Ohm potentiometer.. 8=fixed mica cond. .001 mfd. 9=batt. 45v.
10=fixed mica cond. .001 mfd. 11=phones. 12=mu rad. radio freq. transf. 13=.001 mfd. F.C. 15=federal audio freq. transf.



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No. 250

The "Rico" TUNED Melotone Speaker

THIS loud speaker is the outcome of several thousand experiments, and we present it to the American radio public in full confidence that we have produced the lowest priced and at the same time the highest class loud speaker on the market today.

The "RICO" TUNED MELOTONE SPEAKER is not a makeshift, not a toy, but a high grade scientific instrument, built in very large quantities in order to give the public the advantage of our low manufacturing costs.

These are the specifications:

Adjustable and tuned "RICO" Loud Talker, fitted in cast metal base, handsomely finished, with two coats of baked enamel;
Nickel-plated and polished gooseneck;
Full fibre horn;
Five-foot attachment cord.

THE TUNED FEATURE

Our cross-section diagram shows our new adjustable feature, by which it is possible to make this loud talker give out almost any sound within reason. The MELOTONE SPEAKER can not possibly shatter nor rattle under any circumstances.

The new development comprises a specially-formed, pure Para Rubber Gasket, accurately made, upon which the diaphragm rests. By tightening or loosening the shell of the receiver its diaphragm approaches or recedes the desired distance toward or away from the pole pieces. So remarkable is this adjustment, and so wonderfully exact does it work, that any sound volume or quality can be readily obtained.

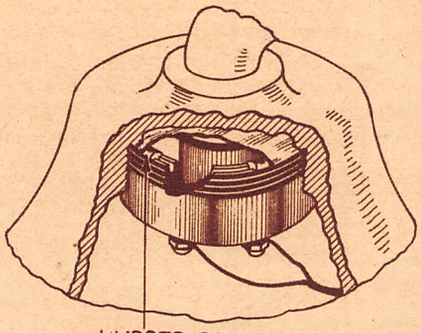
For instance, a given adjustment will bring in certain qualities of sound heretofore unobtainable. It is in your power to **TUNE** the MELOTONE SPEAKER in such a manner that if you wish a moderate amount of sound you can readily obtain it, or if you wish volume, as, for instance, band concerts, the adjustment can be made instantaneously.

By means of this new adjusting feature, the diaphragm can be moved to or from the pole pieces from .006" to .025". To make the adjustment, simply screw the case within the base of the speaker slightly backward or forward. **No screws, no nuts, no fussing, no damaged diaphragm.**

ACOUSTIC FEATURES

After you have listened to all of the expensive loud talkers all we request is that you give ours a trial. You will find that it compares favorably with the most expensive loud speakers on the market

The "RICO" MELOTONE SPEAKER gives quality and volume, without distortion, due to the tuned feature.



On two or three stages of amplification, any good radio outfit with the **"Rico" Melotone Speaker** will bring in the sounds loud and clear to fill a large room or hall. The fibre horn gives the **mellow tone** that is sought by every radio enthusiast. There is a richness of sound that compares most favorably with the most expensive horns on the market today.

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The dimensions are as follows: Length overall, 14½ inches; Length of horn, 11½ inches; Diameter of bell, 6¾ inches; Total height of instrument, 9 inches; Diameter of base, 5 13/16 inches; Total net weight, 3 lbs.

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Order from your dealer or direct from us.

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Try the MELOTONE loud speaker for five days, and simply consider the money you are sending in to us a deposit. If, at the end of five days, you are not convinced that it is the best loud-talker you have ever seen or heard, return it to us and your money will be promptly refunded.

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(*Continued from page* 84)

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New Alphabet for Radio and Land Lines

(*Continued from page* 11)

to each letter, but I refer to the study of the correct method of sending these combinations in any circuit, whether radio, land lines, or submarine cables. The problem is the same in each of these three branches, but it is much more serious in radio for the reason of the necessary broadcasting properties thereof.

The rapid increase in the use of printing telegraphy makes it possible to further consider the telegraph alphabet from the standpoint of the number of the elements and the combinations thereof for each letter. This phase of the problem is now being studied by the Code Section of the Signal Corps.

In the Morse alphabet we find the principle of different time units for dots, dashes and spaces, as the basic idea of the system. In Standard Morse, a dash is three times the length of time of a dot, and the spaces between letters and words are timed correspondingly.

These signals in International Morse are universally emitted into ether from the transmitting antenna in the form of sudden interruptions in the antenna current, or sudden variations in this current. This method produces about the worst possible source of disturbances in the ether space for the reason, among others, that the disturbance has no regularity of any kind, and the speed of operating the sending key has a marked influence on the whole phenomena. Present practice is drifting away from the complete interruption of the antenna current which is the worst from an interference standpoint,

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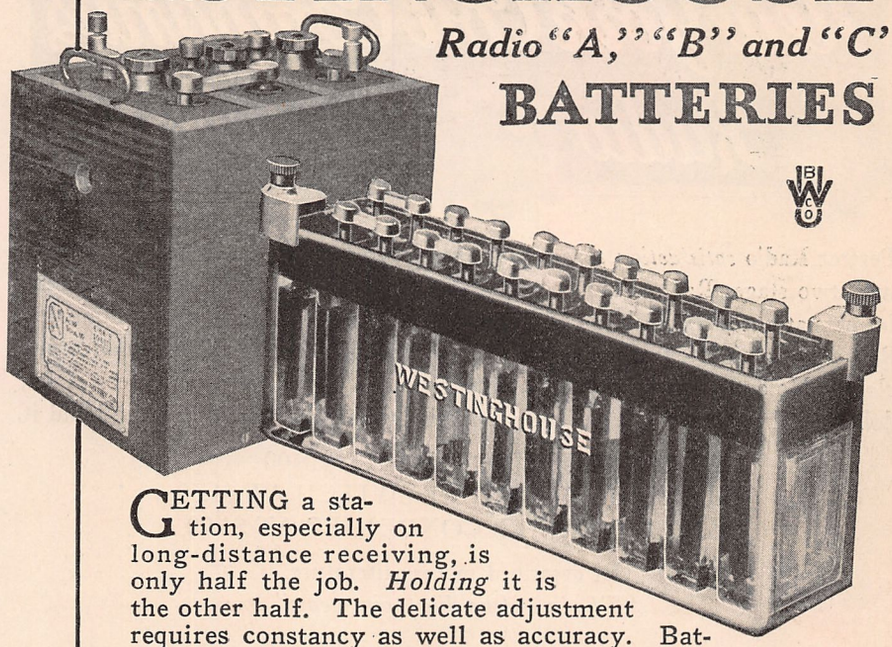
Radio "A," "B" and "C" BATTERIES



GETTING a station, especially on long-distance receiving, is only half the job. *Holding* it is the other half. The delicate adjustment requires constancy as well as accuracy. Batteries must be even-powered as well as full-powered; steady as well as lively; noiseless. Westinghouse Batteries are built for getting the very utmost out of your receiving set. The extra satisfaction you get will repay you many times for your determination to have nothing less than these carefully engineered storage batteries. What's more, their first cost is practically the last—for they'll last indefinitely and can be recharged repeatedly.

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At radio dealers and Westinghouse Battery Service Stations everywhere. Write for illustrated folder.

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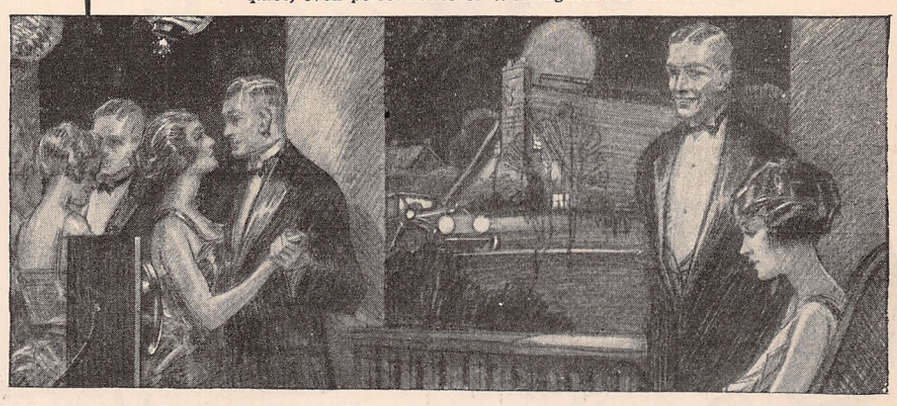

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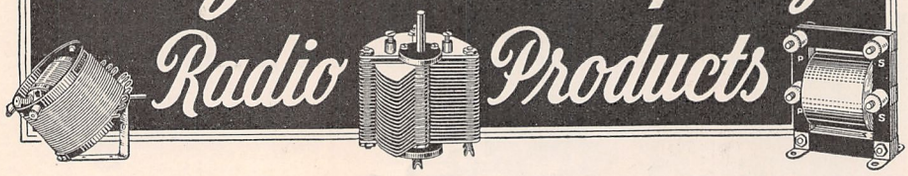

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but the present methods of irregular variations of the current are still a long way from the possible scientific solution.

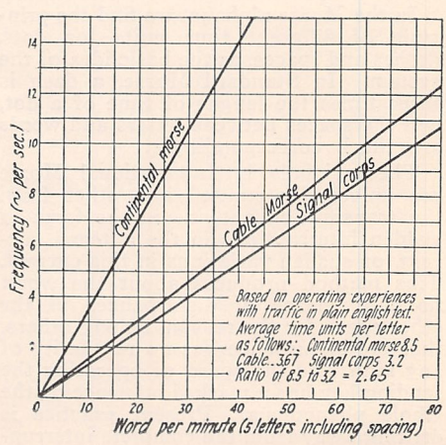
In *1915 the writer was considering the general problem of improving the transmission system for submarine cables, and in connection therewith gave study to a new form of alphabet suitable to such a circuit. The system devised at that time may be described briefly as a continuous-wave system; C.W. versus the "spark" system of the present cable practice. A method was developed of sending an unbroken alternating current through the cable, and means provided for interpreting this alternating current into intelligible signals. This system abandoned the Morse principle of different lengths of time for the signals as being fundamentally inefficient, and adopted the plan that all individual signal units should occupy equal lengths of time, and have equal importance, whether they were dots, dashes or spaces. The signals were distinguished by varying the intensity of the inidividual sending elements; i.e., a dot, dash or space occupied equal time elements, but were of different intensities. The variation in intensity for signaling was effected at the transmitter at the zero phase of the resultant current flowing into the cable, so that, theoretically, at the moment of any operation upon the current there was no current to operate upon.

A point of fundamental importance in this method is that no two adjacent signals are of the same sign, since each semicycle is utilized to effect signaling, giving a dot, dash or space. Other things being equal, the variations in intensities for each of the three elemental signals are reduced to the minimum on the theory that the minimum possible change of the fundamental wave should be made. The reason for this is that an alternating current in the steady state, which amounts to a series of the present cable letters "a" or "n" strung together without space, can attain a speed in any form of telegraphy many times greater than any practical system, for the reason that a single sine wave is transmitted through any form of electrical circuit without distortion of any kind, and, in fact, is the only type of wave that is so transmitted.

A still more important point to be considered is the transmission of the largest volume of telegraphic business with a minimum number of signals, and from this angle the new form of alphabet has most striking advantages.

Fig. 1 exhibits graphically the relative

*"*On an Unbroken Alternating Current for Cable Telegraphy." Proceedings of The Physical Society of London, Vol. XXVII, Part V, August 15, 1915. U. S. Patent No. 1,233,519, July 17, 1917.



Relative Speed of the Various Alphabets Used in Line and Radio Communications.

speeds of the International Morse alphabet, the present cable alphabet, and the alphabet proposed here. It will be noted that by the employment of the alphabet proposed here we gain immediately over one hundrd and fifty per cent in the speed of transmission of signals; the ratio of 8.5 to 3.2, as shown in Fig. 1, is 2.65.

Referring to the cable Morse alphabet, the ratio of 3.67 to 3.2 does not indicate the real advantages of the proposed alphabet. In the present cable Morse alphabet, although the signals occupy equal lengths of time, some of the letters are transmitted by adjacent signals of the same sign. In letters such as "s" or "h", for instance, three and four consecutive signals have the same sign. The additional principle of the Signal Corps alphabet that no two consecutive signals shall be of the same sign, permits, for the first time, a continuous wave of one definite frequency being employed for the alphabet. This makes it possible to utilize, effectively, electrical and mechanical tuning, either or both.

Fig. 2B illustrates graphically this method of modulating a single frequency wave, and shows the words "Now is the time" as they would be transmitted by this method, in which we arbitrarily assign the largest amplitude for a dash, the next size amplitude for a dot, and the third for the spaces between.

Figs. 2A and 2C show two other combinations.

The particular combination 2B has been tried out in actual practice on cables, and has been tested by the engineers of the British Post Office.

If we consider the present method of operating the large radio telegraph stations we find that the method of sending, whether automatic or by hand, has no relation to the phase of the current flowing in the antenna, with the result that in ordinary transmission of a message, the large current flowing in the antenna, sometimes as much as 200 or 300 amperes, is suddenly interrupted or changed in a perfectly haphazard manner. The transmitting key is opened or closed at any indefinite point of phase, with the result that in the same letter or message a large flow of current is interrupted or changed at all possible values from zero to a maximum, positive or negative.

It is well known that the sudden breaking or introduction of high impedances in an alternating current circuit produces a transient phenomenon, which results in a whole group of harmonics being transmitted. Add to this the practical condition of performing this operation upon a current ranging all the way from zero to hundreds of amperes, and it is easily seen that the ether of space is bombarded with a mass of frequencies never twice alike, even in the same letter. It is little wonder, therefore, that no method has yet been devised to prevent such a disturbance from interfering radically with the reception of radio signals. Entirely apart, therefore, from a gain of over 150 per cent in the transmission speed, from an interference standpoint the present method is about as bad as it could well be.

The other source of disturbances in radio is natural disturbance, generally designated as "static" or "atmospherics." Here again it is believed that the solution may be found in the method of sending which is proposed here, for the reason that the modulating frequencies employed are of a very low order, and it should be comparatively simple to devise instrumentaiities which will enable us to differentiate between these low modulating frequencies of the "static" or any other natural disturbance. To emphasize

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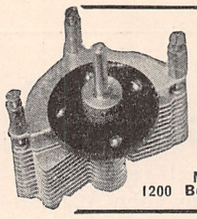

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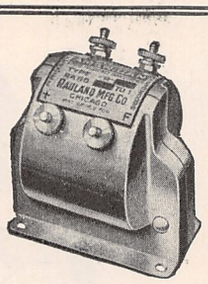

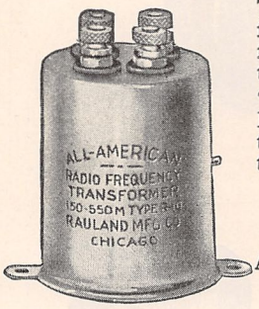

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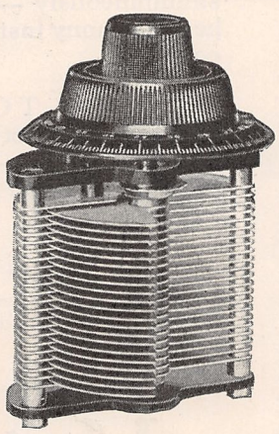

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United Variable Condensers have a wonderful new patented **Vernier Dial Control,** which makes possible twice as fine adjustment as any three plate Vernier on the market.

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3 inch Dials	.35
4 inch Dials Electrose	.95

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my point, by an examination of Fig. 1 it is seen that a modulating frequency as low as 10 per second, which is a very high frequency for ocean cable practice, corresponds to 75 words a minute, which is far higher than any form of sound reception. A modulating frequency of 60 cycles per second, the normal power frequency, corresponds to a speed of 450 words a minute, of five letters each.

If this speed, for traffic reasons, is too great, it is only necessary to make the same perforations in the transmitting tape correspond to a suitable even multiple of a semicycle to reduce the speed to any desired value. For instance, by making each of the signaling units correspond to six complete cycles of current instead of one semicycle, the speed of signaling is reduced to 37½ words a minute, a commercial speed of signaling. In this method of using the alphabet, wave trains are employed as the signaling elements.

The ratio of the lowest frequencies employed in radio to the modulating frequencies here considered is of the order of thousands.

At present the radio engineer has utilized and made his own all of the audio frequency range and at least several octaves of the radio frequency range, and has devised apparatus for the amplification and rectification of both of these ranges, audio and radio. This plan proposes to enter the unused infra-audio range, which would not only add a most useful band of frequencies to those now used, but would give a band below the range of the human ear. If this band were employed for telegraphy, an aditional advantage would be that it could not interfere with any radio receiving. This method of eliminating interferences is the most effective.

Finally, it is seen that by the method proposed here it is possible to modulate a single radio frequency by a number of modulating frequencies, and thus multiply the capacity of each radio frequency channel.

In 1921 the writer attended at Paris an International Technical Conference on outstanding radio problems, and for two months special delegates of the five great powers gave consideration to technical points connected with international radio telephony and telegraphy. Such matters as logarithmic decrements, disposition and allocation of wave-lengths, radiation, etc., were considered. It is now proposed that the general subject of a suitable method for transmitting telegraphic signals either for radio, land lines or submarine cables be considered at the next International Technical Conference,, with a view, if possible, of unifying all branches of telegraphy using the same system of modulation for the signals.

WEAF'S New Broadcasting Studios

(*Continued from page* 11)

DOUBLE STUDIOS ELIMINATE TIME LOSS

The paramount feature of the new studio installation is the use of two studios, a small one for singers, speakers and small groups of instruments, and a second large studio for bands, large choruses and orchestras. Between the two studios is the announcer's booth from which the programs are directed.

The use of two studios will improve the running off of programs because it will obviate much of the delay to which the radio audience is subjected when single studios are used. While an orchestra is

assembling in the large studio, the radio audience will be entertained by soloists or speakers in the small studio. And when the large studios are in use, an artist or speaker is preparing to broadcast in the smaller studio. In this way, programs can be run off with a minimum of delay.

Another feature, which will contribute to the quality of programs, is the special equipment provided in the announcer's booth. It has large windows opening into the studios on either side enabling the announcer to see exactly what is going on in each studio. By means of simple switches, he can put "on the air" the various microphones as required. These include the regular and emergency microphones in the small studio, in the large studio, in the announcing booth and those installed at remote control points, such as theatres, auditoriums, etc.

SPECIAL ANNOUNCER'S BOOTH

The announcer's booth is especially sound insulated so that practically none of the music from either studio is radiated into the booth, which is of terra cotta structure lined with alternate layers of felt and sheet iron. The booth windows are of double plate glass with a dead air space between and are hung in piano felt.

Within the booth is located a small monitoring loud-speaker, actuated by the current output of the studios. The announcer thus hears the studio music exactly as it is sent into the ether for the radio audience, and he controls the placing of instruments and the action of performers in the studio as determined by the radio output, that is, from the standpoint of the radio audience. This new feature eliminates the mistakes in placing of instruments which occur when the announcer or studio director is in the studio where the artists perform. His ear is not able to judge correctly what is going "on the air," from hearing the music being rendered in the studio.

A special loud-speaking equipment enables the announcer to give instructions to artists in each studio and to check up the correct pronunciation of titles and names of selections while broadcasting is going on from the other studio. Through this loud-speaking equipment, also, all announcements are made available to the artists in the studio. In this way, each artist knows how he is introduced to the radio audience and is ready to follow the announcer promptly.

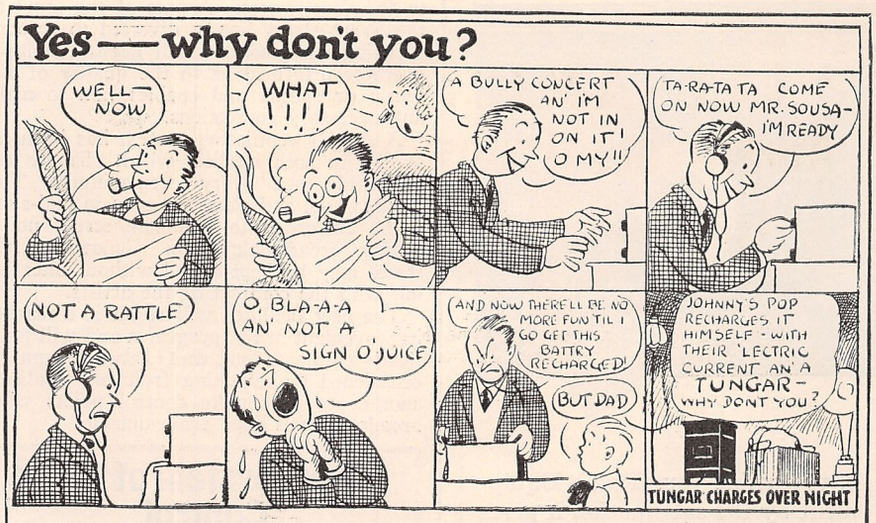
A large and comfortable reception room with doors leading directly into each studio is provided for the artists. A special loud-speaking equipment furnishes them with entertainment while they are waiting. In order to prevent unauthorized entry into the studios, particularly while broadcasting is going on, a special type of door knob is provided, which cannot be opened by anyone unless he knows the special combination. In this way, interruption of broadcasting is made very unlikely.

NEW TECHNICAL FEATURES

The plant department is adjacent to the studio. Here all studio and remote control circuits terminate in a power input panel and are connected with the special line to the radio transmitter located at West street. A system of adjustable distortion net-work is located in the plant department so that the attenuation of lines controlling broadcasting from remote control points can be suitably equalized for radio broadcasting purposes. All remote control will thus be handled at one point by a specially trained crew.

Several new types of measuring instruments have been developed and installed which enable the engineer to determine the gain of amplification attained by any particular group of amplifiers in the broadcasting system.

An input operator is constantly monitoring the currents which pass through the input control panel to the radio transmitter



Does your set "sign-off" because your battery quits?

Are you reminded—when a good program is on—that your outfit is of no further use until you lug the battery down town and back?

Keep the battery at home, keep it full of pep and prolong its life with Tungar.

Tungar—the go-between from house-lighting circuit to storage battery—puts an end to unheard and half-heard programs.

Just connect Tungar—turn on the current and charge the battery while you sleep.

Tungar is *certain, clean, quiet.* No moving parts to get out of order. Inexpensive to operate.

Good for your auto battery too—the same Tungar.

See Tungar at any good electrical shop, or write for literature. Address Section RA7.

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Tungar Battery Charger. Operates on Alternating Current.
2 Ampere Outfits—$18.00
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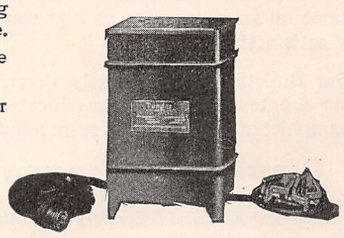
Special attachment for charging 12 or 24 cell "B" Storage Battery —$3.00 —fits either size Tungar.



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A quality condenser at a reasonable price. Low dielectric loss. Rigid mechanical assembly. Fitted as shown, with reduction gearing for fine capacity adjustment. PRICE—Type 247-G Mounted as shown. With gear (calibrated in MMF). $7.25 Other capacities, with or without gear, from $3.25 to $6.00.	Gives the maximum amplification possible without distortion. Like all apparatus manufactured by The General Radio Company, the Type 231-A is guaranteed. PRICE $5.00	A quality rheostat for the new UV201-A and 199 Tubes. A convenient, practical instrument. You'll never cause unpleasant noises in the phones when you rotate the contact arm of a Type 214 Rheostat. For UV201-A and UV199 Tubes, 20 Ohms. For Tubes such as UV201, 7 Ohms. PRICE $2.25

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to 463 West street. A part of the input to the West street line is diverted to a loud-speaking equipment, which keeps the input operator informed as to the quality of the music or speech and enables him to make any necessary corrections.

A special ventilation system has been installed in both studios, which changes the air within them every seven minutes. This assures cool and clean air even in mid-summer. In order to eliminate street noises during broadcasting, the windows to the street may be kept closed without interfering with the comfort of the artists.

The new facilities will result in a marked improvement in the programs and will practically eliminate long waits between numbers occasioned by switching from one studio to another or to remote control points when broadcasting is done from outside.

A New System of Radio Control

(*Continued from page 20*)

Our fourth problem was to correct one of the inherent weaknesses of the tuning fork when used for this kind of work. The inertia which causes it to resist going into motion also makes it continue to vibrate for an appreciable length of time after the exciting force has been removed. For instantaneous control this is a distinct disadvantage. The writer overcame this by using forks in pairs, the first to operate and the second to release the object controlled.

It should now be possible to follow the diagram marked (A). When the key of fork A, at the transmitting station, is pressed, its frequency is imparted to the carrier wave. At the receiving station when properly tuned this wave, built up by the power amplifier, actuates the microphonic relay opening and clos-

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Murdock Phones, 3000 Ohm	6.00	4.90
Acme Transformers	5.00	4.20
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Dreyfuss Phones	8.00	7.00
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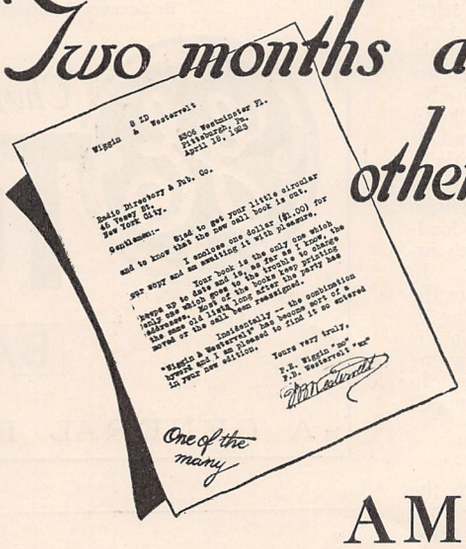

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2 OM
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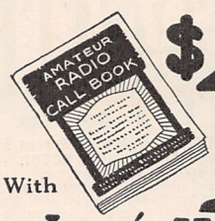

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Dealers write for proposition.

Radio Directory and Publishing Co., 45-C Vesey St., N.Y. C.

ing the contact at the frequency of the transmitting fork A. These impulses are conveyed to coils of the receiving forks. Fork A^1, which is in resonance with transmitting fork A goes into motion, closes a contact, and operates and locks a relay. This relay turns on light L, a symbol of power. Likewise with fork B and B^1; they operate a control relay that restores first circuit to normal, thereby extinguishing light. Having proven our own case for two forks, the number of combinations for differential control is limited only by the number of frequencies in the lower audible range. Harmonics must be avoided. A harmonic is the near multiple of a fundamental frequency. This system was successfully demonstrated on November 24, 1922, to the American Institute of Electrical Engineers at Ohio State University. Owing to the large number present, the members were taken through our laboratory in small groups. The system worked perfectly and caused no embarrassment to the lecturer.

It should occur that the key to this system is the microphonic relay. The principle of this relay has long been known, but its application has never proved practicable in radio in the past. The reason is the small currents of the crystal and lamp detector, but with the advent of the power amplifier, especially the Western Electric type, using the push and pull system, and with efficient receivers of the Baldwin type, this relay may be found to have very sound principles. From actual observation we believe that with proper construction and power behind it this relay will meet the demand for a "coherer of quick enough action" for ideas not only in "control" but in other radio fields. It may be interesting before leaving the subject to know that we have been able to demonstrate some very simple and yet extremely useful experiments with this relay, such as ringing an ordinary telephone bell. This bell responds to an A.C. current of about 80 volts and a frequency of 16 cycles per second. In our first experiment we placed a biasing spring on one side of the armature so as to hold the clapper against one of the gongs. The bell was then wired through a battery to the microphonic relay. The battery influenced the armature magnetically opposite to the pull of the spring. At the transmitting station the vibrations on the modulation circuit were slowed down to 16 cycles per second. These impulses at the receiving station opened and closed the microphonic relay at the required frequency and rang the bell. See diagram (B). The disadvantages here were that the battery was connected at all times, and the bell altered from an A.C. to a pulsating ringer. Our next improvements were as follows: we used a Baldwin receiver; we soldered a platinum contact on the small metal disk of the center of the mica diaphragm; we cut a strip out of the cap and stretched a wire cross the diaphragm. A platinum sleeve was placed on the wire just above the platinum contact and a thumb screw drew the wire taut. By a screw adjustment the distance between the platinum sleeve and the contact on the diaphragm could be regulated. Now when the receiver was agitated by a slow audio frequency of 16 cycles from the transmitting station the diaphragm moved up and down over an appreciable distance, engaging the platinum contact of the diaphragm and the sleeve. This type of suspended contact has no damping effect on the diaphragm. The receiver retains its aperiodic nature for any frequency except the fundamental of the wire, which can be made very high or changed. Temperature changes have no effect; when once set, it holds its position. It provides a frequency relay with an open contact. We wired the relay to a bank of batteries of 24 volts, then through the primary of a transformer having a secondary ratio of three to one, or an output of about 75 volts. We then connected a polarized bell, without biasing spring, to the secondary. The bell

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The Dollar Radio Receiving Set

The Simplest Radio Outfit Made —Yet as Practical as the Most Expensive!

You need know absolutely nothing about wireless to operate and enjoy the RADIOGEM. It is so sturdy, so simply constructed that it is small wonder radio engineers who have tested it have pronounced the RADIOGEM a brilliant achievement. The RADIOGEM is a crystal radio receiving set for everyone at a price anyone can afford.

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I am enclosing herewith $1.00 to pay for the Radiogem. I had it carefully wound by our wireless operator and find that it works beautifully—**fully as good as any crystal set we know of.**

Radiogem received, which we assembled and were very much astonished at results obtained and the clearness and volume of tone produced.

The greatest distances I heard on one of your sets is 1000 miles, having heard WGY at Schenectady, N. Y. I think **your set is the best I have ever sold at any price.**

On an aerial 160 feet long and 20 high one of my customers has heard WOC and WHB, KSD, WMC on one of your sets using a Peerless headset.

Herewith P.O.M.O. amt. $1.00 for another "RADIOGEM." The one received is O.K. Placed about 15 ft. of picture cord under front porch and grounded to a gas meter, and heard the Sacramento Bee and Sacramento Broadcasting Union **much better than with my large crystal set.**

Your RADIOGEM RECEIVER is a wonder. I have received every station in Philadelphia with **it much louder than with a high-priced crystal set.**

Your two Radiogem sets received last night, and one was wired up for testing. WOC is about 40 miles away, and their signals could be heard with headphones on table. After they quit KYW at Chicago about 170 miles east was heard. Every word could be plainly heard here. WMC at Memphis, Tenn., could also be easily heard and understood.

We find that this set does a great deal more than you claim for it. We took WEAR on our audion set last night; this being the Baltimore American Broadcasting station, and then cut in the Radiogem and got excellent results. After the Baltimore concert was over, we continued to use the audion set and about ten o'clock were listening to WEAF—New York—and a little later we disconnected the audion set entirely and hooked up the Radiogem, very clearly hearing both piano music and announcement of name of station and its location.

You claim a radius of 20 miles over your "Radiogem" is sometimes a possibility. You should adhere to the truth. I constructed one for my mother, installed it with an aerial, and she listens not once in a while, but at her will, to Schenectady, Newark, New York, or Providence, R. I., and her home is Attleboro, Mass. **I can't give your set too much praise.**

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The result is a Fibre that is three times as tough as leather. No ordinary force can crush, break, crack or split it. Its tensile strength is from 9,000 to 14,000 pounds per square inch, with a resistance to shearing up to 13,000 pounds per square inch, and an electrical rupture up to 400 volts per Mil.

We have made Vul-Cot Fibre with such care, with such minute attention to every detail that we can guarantee it to be free from impurities.

If there is a place for fibre in the composition of your product—if there is a possibility for a material that is as hard as horn, as durable as steel, as adaptable as rubber and yet less costly than any—we will gladly place at your disposal the experience gained through years of making parts for the products of the host of manufacturers who use Vul-Cot Fibre.

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In Bulletin No. 32, the U. S. Bureau of Standards says: For all wiring—antennae, grounds, etc.—use Copper.

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RESEARCH ASSOCIATION
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rang loud and clear in response to a call from the transmitting station. See diagram (C). Both of these bell devices have been successfully demonstrated at the University. This device will operate with A.C. on the filament. The 60-cycle hum of house lighting current is not strong enough to operate the relay, and in addition the bell is designed for 16 cycles. A switch for stand-by periods meets the question of wear on storage batteries. The excessive cost of tubes will take care of itself soon by patent expirations.

The important point in these developments seems to be that there is nothing complicated in radio control. The equipment here is of the most simple, everyday type. The methods used are old fashioned principles rehashed. The power amplifier has made this possible. In reviewing these developments the one which seems to have an immediate application is the bell-ringing device. A number of radio bells have appeared from time to time in the scientific papers. It is for you to keep on experimenting. The public will pick the more practical of these and put it to work. One of the present needs for an automatic signaling device in radio is in connection with the radio telephone systems installed in the police headquarters of the larger cities. With any kind of a signaling device, the stand-by charges for these stations can be reduced. The man who has to sit listening for calls can be released for other duties. When such a system is established, radio will have taken a step forward in placing itself alongside of its present competitor, wired telephony.

In concluding, we have this message for the radio experimenter. Bear in mind the premium that the world pays for simple effective ideas. Reflect that in the early seventies the great Western Union, with its vast financial resources, was powerless in its fight against Bell when he handed to the world an idea for a telephone based on simple, practical and economic principles. Neither can the great communication corporations of today, hostile to radio amateurs, stand in the way of the humblest if he can bring forward an idea which the public can really use. For such there must, of course, be a time, a place and a demand. Radio control meets these conditions, and is calling upon you for ideas.

The writer takes this opportunity to publicly thank the electrical house of Hughes Peter Co., the Heaton Musical Stores, and the jewelry firm of Bancroft Bros. & Co., of the City of Columbus, for their generous donation of equipment and labor in connection with the writer's efforts, also the public press of this city for its sympathetic support. He would like at this time to acknowledge his indebtedness to his associate, Mr. Paul G. Edwards, for invaluable suggestions, and also the assistance of the student staff, Mr. Bejcek, Mr. Mitchell, Mr. Gravitt and Mr. Arter. To the untiring efforts and enthusiasm of these young men the success of our efforts along radio control is due.

General Electric Co. to Install Two More Broadcasting Stations

(*Continued from page 29*)

ica and the Westinghouse Electric. This plan contemplates the erection of nine large broadcasting stations. Of this number the Westinghouse has now three in operation, those at Pittsburgh, Pa., Chicago, Ill., and Springfield, Mass. The New York station of the R. C. A. is on top of the Aeolian Building on 42nd street and was opened recently. The General Electric Company now operates WGY at Schenectady, N. Y., and will have a second station near San Francisco and a third somewhere between the Pacific Coast and Schenectady, N. Y.

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Write for complete price list.
Simplex Radio Co., 1806 Lafayette Ave., St. Louis, Mo.

A Portable Set for the Vacationist

(*Continued from page* 44)

shaft hole in the antenna circuit variometer which, as may be seen from the winding diagram, goes to the condenser.

2. A flexible lead through the shaft hole of the plate variometer which goes to one of the phone binding posts.

3. A lead from the end of the tickler winding. This is soldered to the shield after the tube has been fastened to the panel by a bracket at either end.

4. And lastly a lead from the stator of the plate variometer which goes to the plate of the tube.

This practically completes all constructional work and the set can now be assembled.

The tube is mounted vertically behind the left-hand side of the panel with the antenna variometer at the top. To the right of the tube at the bottom on a line with the plate variometer is placed the rheostat. Above the rheostat is the tube socket. The wiring of the set is a simple matter and should preferably be of the busbar type. By consulting the wiring diagram any details which have not been made quite clear should be easily seen.

A Convenient Series-Parallel Switch

(*Continued from page* 47)

the points at a time. The two blades are insulated from each other, but as no connection is made to the screw which holds the knob, one blade can make contact with the screw in the ordinary manner.

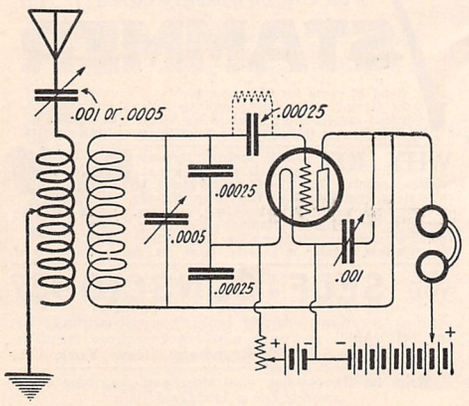
To insulate the other blade, make the hole large enough so that the blade will not touch the screw and then separate the two blades by a fibre washer. Both blades should be as narrow as possible where they come near to each other, to aviod a capacity effect.

The switch can be mounted on any panel. It takes up but little room and is neat in appearance.

Contributed by Paul McGinnis.

UNIVERSAL RANGE REGENERATIVE HOOK-UP

Many amateurs are not making use of their long wave loose couplers because they have no tickler to use with them to receive



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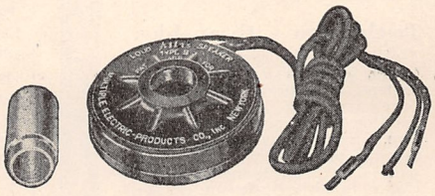

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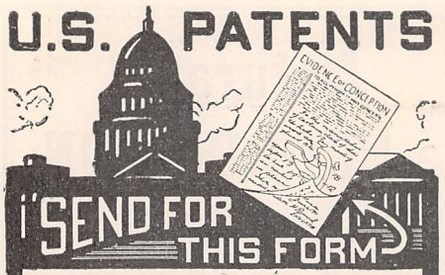

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the long wave telephone broadcasting, but I am quite sure this hook-up will give pleasing results on all wave-lengths where regeneration is required.

Instead of a wire wound tickler a condenser takes its place and by the use of a double circuit much interference is eliminated which is ordinarily audible in single circuit sets; this hook-up allows the regeneration of waves at any wave-length without a change in the circuit.

Contributed by Everhart Turner.

The Antenna and Its Relation to Detection Efficiency

(*Continued from page 32*)

into the secondary is thus reduced and the paralyzing effect avoided. It will also be clear, therefore, that this arrangement will simultaneously reduce interference from such stations by reducing their effect on the detector.

REGENERATIVE TUBE DETECTORS

We come finally to the case of sets employing regeneration. Here the conditions for maximum efficiency in detection are entirely different from the above cases. Armstrong has shown that where regeneration is employed maximum sensitivity in detection is secured when the signal voltages applied to the grid of the tube are extremely small. The smaller the voltages thus applied, the more sensitive is the tube as a regenerative detector. Here we have a case almost the exact opposite of the non-regenerative tube detector. Since this is true, it is evident that with a regenerative set we can dispense with long and high antennae, for nearby reception since the long and high antennae yield large signal voltages, which in this case produce inefficient reception. To secure the necessary low voltages for the regenerative tube detector, we have three possibilities:

1. The use of a loop antenna. This will generally be inadequate for most purposes, unless the receiving station is located very close to the broadcasting station, because the signal voltage thus developed in the loop will be entirely too small to actuate the detector. It should be remembered that while the regenerative tube detector is most sensitive on small applied voltages, there is a lower limit beyond which the tube will not respond to the signal. In such cases it is necessary to employ one or two stages of radio frequency amplification to secure results. But where the receiver is close to the transmitter, the loop will be found to be fairly satisfactory.

2. When using a long and high antenna, the use of the above mentioned loose coupler or variocoupler will be found to give relief from insensitiveness. For by reducing the coupling between the antenna and secondary, the amount of energy transferred into the secondary from the antenna is reduced and thus the voltage applied to the grid of the tube detector is also reduced, thus giving the required low voltage. Now this feature has a great advantage, which is its adjustability, for the coupling, and hence the applied grid voltage may be varied until the maximum loudness is secured in the phones.

3. The third and possibly best direct way to secure the necessary low voltage to give maximum sensitivity in detection on regenerative sets is the use of short antennae. Since the long and high antenna gives high voltages, the short antenna will give low voltages. This probably explains why so many people using regenerative sets are getting such good results by using a wire running around the wall moulding, or by using a single wire running through the hall. These antennae are short and low compared

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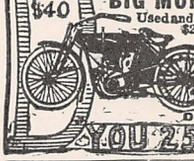

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to outside antennae, and therefore develop the necessary low voltages in them.

We thus see that here is a case where long and high antennae are not essential to sensitivity in detection, and that a low short antenna will sometimes yield good results. This should be very carefully considered by people buying or using such regenerative tube sets, especially if their landlords have objections to the installation of antennae on roofs, or where it is impossible or impracticable to install long antennae. Short antennae, and low ones, may be easy to install, and some landlords may not have any objection if they are shown that it will be short and low. Furthermore, in the event of difficulties even with the installation of short antennae, there is always the stand-by of the indoor antenna, of one or two wires. A single wire in the ordinary hallway or run around the moulding of a room will give a sufficient volume signal to operate the phones and be heard when phones are pulled away from the ear. And, as the writer witnessed the other night, a single wire about 15′ to 20′ long running through a hallway operated a regenerative set with two stages of amplification so that the music, when applied to a pair of receivers in an ordinary phonograph horn (no loud-speaker) was heard very loudly throughout an entire flat of five rooms. People intending to install receivers will do well to give this matter their attention to their own advantage, and thus avoid antenna installation trouble, which often holds many people back from buying radio sets.

New Development in Tubes

(*Continued from page* 31)

30 ohms per tube. If a six-volt storage battery is used, the resistance should be at least 60 ohms. In multi-tube sets the sockets for the tubes should be cushion mounted so as to minimize the effect of vibration.

With any vacuum tube, and particularly with the UV-199 tube, the changing of connections, or adjustments of the wiring of the set is dangerous unless the tubes are removed from the sockets or the "B" batteries entirely disconnected. Inasmuch as many adjustments can most advantageously be made while the set is in operation, it is strongly recommended that a protective resistance be placed in one lead of the plate battery, preferably immediately next to one battery terminal. An almost ideal resistance for this purpose is a 10-watt, 110-volt tungsten lamp.

Radio Broadcasters Oppose Publishers

(*Continued from page* 30)

ments increased 125 per cent during the month of March and that the largest manufacturer of records in the country went on record as saying his business had increased 45 per cent since April first.

Then again it is said the American Society controls a comparatively small amount of the music published in America—something like thirty per cent of the total.

The new broacasting association starts auspiciously with a guarantee underwritten of $1,000 by each member. Catalogs of music that may be broadcast without license fee or royalty, will be published. The American Society is said to be eager for a test of the legality of their claims but the broadcasters rather than wage an expensive court battle have decided to refrain from

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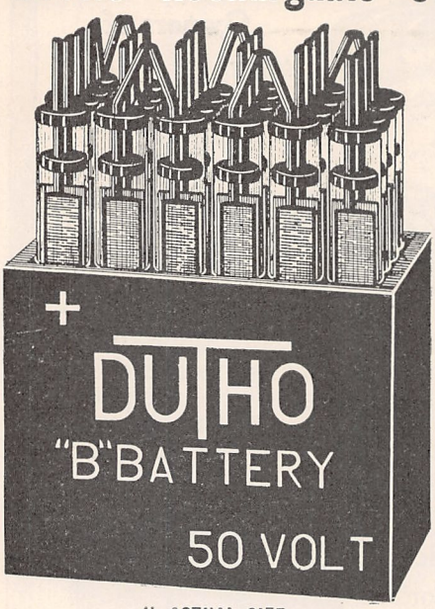

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Temporary officers of the National Association of Broadcasters are Thorne Donnelly, WDAP, president; Powell Crosley, WLW, Cincinnati, secretary, and E. F. McDonald, Jr., Chicago Radio Laboratory, treasurer. Charles E. Erbstein, of WTAS, will act as attorney and has announced his intention of carrying the differences of the publishers and broadcasters to the Supreme Court of the United States if necessary. Mr. Erbstein said the broadcasters make no money but on the other hand give the music priceless advertising.

Awards of Our Prize Contest Who Will Save the Amateur

How to Save the Amateur

By THOMAS C. HOWARD

6th Honorable Mention

If we are going to try to save the amateur by making him a necessity to his community, one of two things is sure to result. Either the amateur will become a professional, or he will be disposed of. Who will make his services a necessity unless he receives pay? It is, I think, evident to most of us that continued voluntary services are not to be depended upon when there is neither pay nor urgent need. And in the eyes of the "broadcast fan" the amateur transmitter is nothing more or less than a nuisance.

Let us not forget the meaning of the word AMATEUR. An amateur is one who pursues a study or cultivates an art because of his love for it; and he expects no financial gain.

It has been suggested that the amateurs could become a force and thereby uphold their rights. Is this not precisely what the American Radio Relay League is working for? *Moreover, the fact that thousands of relayed messages never reach their destinations only goes to show that the average amateur will not inconvenience himself to any great extent.*

How to save the amateur transmitter is a difficult question, and will, I think, be solved ultimately by a wider difference in wave-lengths.

However, granting that this change in wave-lengths can not be accomplished, I suggest the following plan:

1. Promote C.W. transmission. Encourage those who have only receiving sets to learn the code and to install transmitters. Let the retail dealers hold free code classes in their shops. To do this would be a most excellent advertisement and would be a great thing for the radio business in general.

2. A complete transmitter, at a reasonable price, should be placed on the market. (The panel transmitters already on the market are, in my opinion, too expensive.)

I wish that those who do not agree with my plan would bear in mind that it will take persons with initiative and energy to dispose of the amateur transmitter. Consequently it is reasonable to believe that these same persons would be energetic enough to spend a short time learning the code, if the chance were, so to speak, forced upon them.

Whether or not the amateur is driven out of existence depends entirely upon the radio manufacturers and dealers.

If my plan is not a good one, or if I have not said enough, you must concede that it is, at least, an idea.

How to Avoid the Conflict Between Amateurs and Broadcast Listeners

By L. R. FELDER

7th Honorable Mention

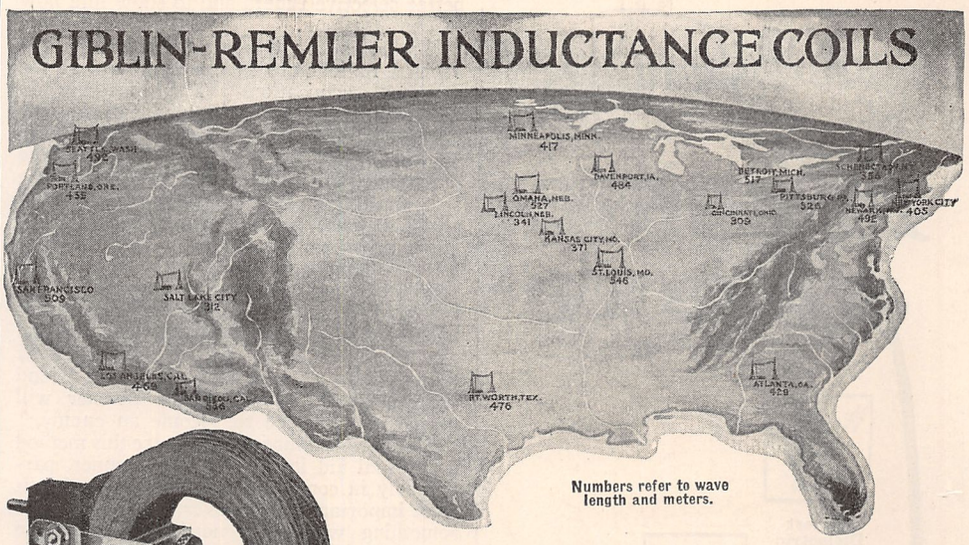
With the ether becoming more and more congested as the broadcasting increases, it is not surprising that interference is being created to such an extent that bad feeling arises between the two factions involved, namely, the technical amateur and the new group of broadcast listeners. Considering what the amateur has done for radio, it would be a shame if he were crowded out, now that the fruits of his labor are available to all. On the other hand, the amateur must face the facts as they are and not as he would like them to be. Fifty thousand of him cannot buck a few million people, and the rights of these people must be considered. Developing a bad temper does no good in this case, and it is up to him, the intelligent amateur who knows radio, to find a way out of the confusion, so that these millions of people may enjoy what is being sent out for them. In this way he will be doing another great service and putting these people under still further obligations to him.

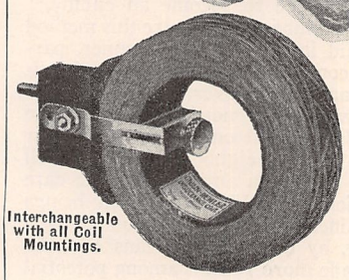
The following ideas are advanced in the hope that they may be of use in saving the amateur. Amateur transmission takes place supposedly at 200 meters. Broadcasting is done mostly between 360 and 500 meters. Ordinarily, if sharply tuned transmitters and receivers are employed, there will be no interference. But the fact remains that there is interference and this is causd by the amateur transmitters having broad waves and the receivers being broadly tuned. If both these conditions were remedied there certainly would be little interference to talk about and harmony would exist between the two conflicting factions.

The broad waves of the amateur transmitters are almost entirely due to the use of spark coils and spark transmitters. They cannot avoid radiating broad waves with this apparatus on account of the inherent characteristics of spark equipment. However, with the development of C. W. apparatus which has been accomplished to date, there is no reason why the amateur should continue to use spark apparatus. It is largely inertia on his part that he still continues to use sparks. Of course, there is the expense involved, but the average amateur spends so much money on other parts of his sets and upon his receiving and amplifying equipment that it would not be asking too much to ask to have some of this set aside for transmitting equipment. C. W. permits of radiating sharp waves, and has so many other advantages over spark transmission that it is surprising indeed that the amateur still uses sparks. The least that the spark transmitting amateur can do is to scrap his old spark set and install a C. W. outfit. With C. W. half his interference problem will be solved.

The next question in this conflict is the use of sharply tuned receivers. It is well known that the broadcast listeners mostly use broadly tuned single circuit receivers, or broadly tuned double circuit receivers (the latter due to poor design). The reason these broadly tuned receivers are used is that they offer the line of least resistance to the operator, as they are much easier to handle than other sets. Of course, they cannot be blamed for this, as they do not know enough about the technical end of radio. You can't simply tell a novice that if he had a certain type of selective tuner he would not have interference and that it is easy to learn how to operate such a selective tuner. It is easy for the amateur because he has learned by considerable experience. It is, therefore, up to the amateur who knows to teach the novice about these

GIBLIN-REMLER INDUCTANCE COILS





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—the basic and correct system for receiving over the entire range of broadcast wave lengths—228-546 METERS

Under the new assignments recently made by the U. S. Government, radio stations are now broadcasting on wave lengths ranging from 228 to 546 meters. It is, therefore, necessary that your receiving set operate efficiently over this entire range of wave lengths. For this purpose sets using Giblin-Remler coils are ideal. As shown in the table when using condensers of .001 microfarads capacity a single set of coils may be selected that will satisfactorily cover this entire range.

Type and Number of Turns, Mounted	Price, Mounted	Type and Number of Turns, Unmounted	Price, Unmounted	Inductance in Millihenrys at 1000 cycles Accuracy ½ per cent.	Natural Wave Length in Meters, Accuracy ½ per cent.	Distributed Capacity, in micro-micro-farads, Accuracy 1 per cent.	Wave Length Range in Meters using Condenser of .001 max. and .00004 mfd. min.		High Frequency Resistance in Ohms at Wave Length shown.			
							Min.	Max.	200	500	1000	2000
RG 20M	1.50	RG 20U	.70	.030	39	14.3	63	334		1.1		
RG 25M	1.50	RG 25U	.70	.041	47	15.2	75	389		1.5		
RG 35M	1.50	RG 35U	.70	.083	87	25.4	128	550		3.5		
RG 50M	1.60	RG 50U	.80	.169	114	21.6	185	785		8.8	4.4	
RG 75M	1.65	RG 75U	.85	.377	163	19.8	266	1170		28.3	12.1	6.2
RG 100M	1.70	RG 100U	.90	.666	217	19.9	358	1550		80.3	26.8	12.6
									1000	2000	5000	10000
RG 150M	1.75	RG 150U	.95	1.503	281	14.8	512	2320	69.8	23.8	7.1	
RG 200M	1.80	RG 200U	1.00	2.68	374	14.7	690	3110		50.6	12.5	
RG 250M	1.90	RG 250U	1.10	4.20	424	12.1	860	3880		87.5	19.9	
RG 300M	2.00	RG 300U	1.20	6.11	494	11.2	1030	4680		141	29.3	13.8
RG 400M	2.10	RG 400U	1.30	11.04	618	9.7	1380	6300			54.6	22.3
RG 500M	2.30	RG 500U	1.50	17.50	747	9.0	1730	7900			93.1	34.9
									2000	5000	10000	20000
RG 600M	2.40	RG 600U	1.60	29.2	1024	10.1	2260	10250		111	43.8	
RG 750M	2.65	RG 750U	1.85	39.0	1249	11.3	2660	11850			64	
RG 1000M	3.40	RG 1000U	2.50	71.6	1620	10.3	3570	16000			123	
RG 1250M	3.80	RG 1250U	2.90	108.0	1930	9.7	4380	19700				
RG 1500M	4.40	RG 1500U	3.50	159.8	2300	9.3	5300	23800				

These tests have been made by Robert F. Field of Cruft High Tension Electrical Laboratory, Harvard University, Cambridge, Mass.

In addition to this novel feature the Giblin-Remler coils, due to their special winding, have *maximum inductance and minimum distributed capacity* for a given number of turns. These two important electrical features insure *maximum selectivity and greatest signal strength* under any given condition.

The use of Giblin-Remler coils also insure greatest possible flexibility. By merely changing one or more of the coils your set may be made to cover any desired range of wave lengths.

Write for Bulletin N giving complete information, table of constants and prices on Giblin-Remler coils.

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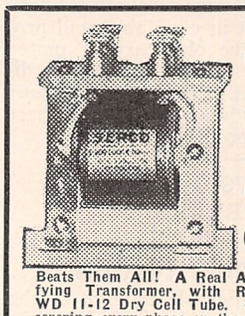

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2000 Ohm Murdock No. 56 Head Sets	3.75
3000 Ohm Murdock No. 56 Head Sets	4.25
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better selective tuners and to show him how to operate them.

The basis for this instruction is in the various radio clubs in existence and in the national organizations. The amateurs in these organzations and clubs can become acquainted with the people in their vicinity who are installing sets or who already have sets. They can assist in the installing of the sets, and then in teaching them how to operate their sets. At the same time they can begin injecting the germ of double circuit selective tuners, teaching them in a simple way the theory and how to handle such a tuner. People are intelligent and just as he has learned, so can they. In this way he can work his way into the confidence of the broadcast listener and will make a friend of him before the broadcast listener will have had a chance to become an enemy.

The various clubs can organize this method of mutual aid in a systematic manner, particularly in congested districts where this is most important. Whenever any novice finds something wrong, or needs some aid, he should be able to call on the radio club or organization in his neighborhod, which will immediately assign an amateur to take care of his particular problem. Human beings are socially inclined and before you know it the amateur, by this simple means of help, will have made more friends among potential enemies than he ever dreamed of. And he will find that not only will there be less complaints about interference, but that the broadcast listeners will stand up for his (the amateur's) own rights to the ether.

The novices should be invited to the meetings of the amateur's clubs and it should be arranged so that periodically there will be a "novice's night" where the most capable and best informed amateurs will give simple instruction and talks on the operation of receivers. Here there will also be an opportunity to install in the minds of the novices the germ of the selective tuner with more than one control. By demonstration the amateur instructor will be able to show them the difference in operation between a broadly tuned receiver, such as commonly seen in any store, and the multi-controlled selective tuner. The novice will actually see and hear the difference in operation between the two and will be able to understand that it is not always the fault of the amateur that interference exists. Nothing talks so much as being shown.

The novices can be induced to come to these meetings easily. All the radio journals will be only too glad to publish dates of meetings and announcements of such a mutual aid policy. In brief, help the novice and he will help you.

These are, of course, simple devices, nothing revolutionary about them. It might be said that they have been tried; the answer is that they have not been tried. Individuals may have done so here and there, but no organized, concerted effort on the part of the technical amateurs has been shown, and it is this organized, consistent effort, done with the above object in view, that will produce results. It's the old story of united effort accomplishing something, where divided effort does not. So, if the amateurs band together and push, as indicated, there will be no amateur problem.

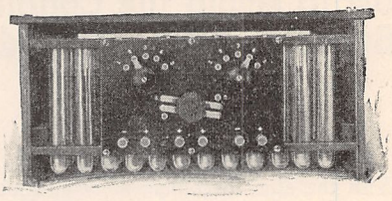
AMATEURS VS. BROADCAST LISTENERS

By H. F. ROOK

8th Honorable Mention

I have given considerable thought to the problem of saving from the junk heap the millions of dollars worth of fine radio apparatus used by the long distance radio amateur and also how to save the still more valuable work put by these men into their relay and record making work.

It is plainly evident that the increase of powerful broadcasting stations will surely make this relay work immensely difficult if



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Prices without rectifier:	16 cell	22 volt	$ 5.50	
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not impossible and also that there is a rapidly growing public sentiment against telegraph work because it interferes with broadcast reception.

My solution of the problem is this: Let us keep the amateur relay stations about as they are (except that sparks will have to give way entirely to tubes) and let us have the amateur continue to relay, BUT, let him stop relaying unimportant personal messages and start RELAYING BROADCAST PROGRAMS.

In this way the radio amateur can serve a vast number of people in outlying districts and a still greater number of people of small means, by receiving the broadcast programs on 360, 400 or 1450 meters and simultaneously retransmitting them on 200 meters.

Here also is an outlet for his love of making records and would, in my opinion, tax his cleverness to the utmost to receive the broadcast programs and retransmit them without distortion and with maximum power.

In this way the radio amateur, who is fast becoming a thorn in the side of the public, may so change that sentiment as to have that same public praise him in the highest terms.

IS THE RADIO AMATEUR DOOMED?

By REX DURRANT

9th Honorable Mention

Who will save the radio amateur? the Editor's striking article in October RADIO NEWS has surely made all real amateurs think, and think mighty hard. But through the maze of "Radiophonology," in a rift of the Radio Popularity wave there is calm!

The "true as steel" bug has seen that the artist in the illustration has made one ripple too many.

The radio amateurs are forming into companies, and, as one huge battalion, are retreating steadily but in orderly formation to the higher ledge of rock bottom scientific investigation on the wave-lengths of the future.

Gone is the 150-200 meter station—cross off that extra naught—*20 meters!* That is where the amateur of the future will experiment, investigate and *work.*

The gramaphone "let's hear the Jazz crowd" will be left. Right down there on a length undreamt of by we old hands who recall spark days.

Not many moons will pass ere this great field of scientific research is opened.

By whom?

By the radio amateur. Once more he will give the lead to greater discoveries still.

Glance again at the illustration! What does your "thought form" materialize into? . . . . the huge wave has subsided—the waters are calm—the radio amateur is saved.

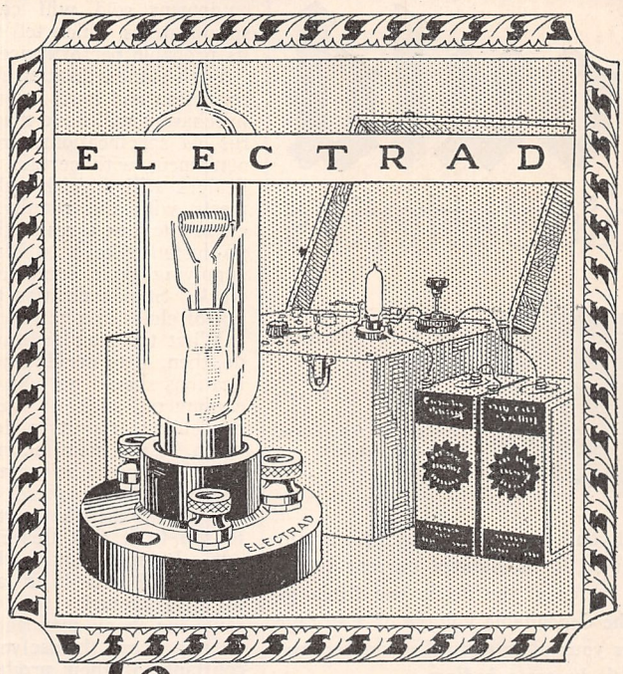
By whom?

By Himself.

What Standardization Means to the Radio Buyer

(*Continued from page* 13)

know something about the apparatus, and will have some idea as to what its performance will be. In the case of condensers, the minimum and maximum capacity of variable condensers should be given. In this case it would even be desirable to have a calibration curve go with the condenser. For fixed condensers, the power factor should be given also. Variometers have two constants of great importance to the user: Inductance and resistance. The minimum and maximum inductances of the variometer should be given together with the high frequency resistance at a specified wave-length.



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Price $2.

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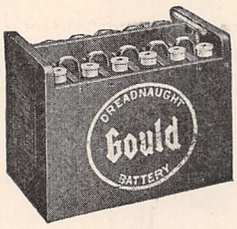

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The sound you hear actually comes from your "B" battery. Its modulated current is the electrical source of the music you listen to. Without the dependable voltage of a storage battery for your plate circuit, sound becomes *noise*—music becomes *bedlam*.

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Gould Radio "A" Battery. Used by the various Radio Branches of the U. S. Government. 60 A.H. to 160 A.H. $18.00 to $33.00 f.o.b. factory.

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—Audibility amplification, 38.6—
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In a similar way when the entire industry has been standardized, every piece of radio equipment sold will carry with it those specifications which tell the purchaser what its probable performance will be.

With standardization in vogue, much less confusion and hard feelings will result; the purchasers will have marked on the apparatus its specifications, or they will ask for equipment with certain specifications. The dealers will furnish only such material as meets with the requirements of the purchaser, and as a result the purchaser will in no instance have to blame the dealer for supplying poor equipment which does not work. Standardization means making order out of chaos in a new industry such as radio.

What the standardization conference will do, then, is to decide on exactly what specifications should go with each piece of radio equipment, such as variometers, couplers, condensers, rheostats, leaks, receivers and so on. Each manufacturer will be informed as to the specifications which are to be supplied with each piece of radio equipment and it will then be up to the manufacturer to see to it that this information is given out. It may require that many manufacturers will have to install measuring outfits in their factories to determine these consants, as many manufacturers undoubtedly do not know themselves exactly what the constants of their products are, but in the long run this initial expense will be well repaid and will only be beneficial to the industry as a whole. Those manufacturers who refuse to furnish such specifications will be under no penalty except that which the buying public imposes on them when they insist on buying only standardized merchandise.

Practical Radio Slide Rule

(*Continued from page* 51)

METHOD OF OPERATION. LAYER TYPE INDUCTANCE COIL COMPUTATIONS WITH SPECIAL RULE

To find the inductance of a single layer coil when dimensions (in inches) are known, rotate the disc until the Index arrow points to *the intersection* of the Length and Diameter curves. Count the actual number of turns per inch of winding. The inductance of the coil will be found exactly opposite the location of this value on the Turns per inch scale. It may be necessary to interpolate between the curves, if the coil has an odd length or diameter. The Diameter curves are represented by concentric semicircles, the length curves by oblique curves across these semicircles.

For two-layer bank winding multiply inductance value so obtained by 4.

For three-layer bank winding multiply by 9.

For coils with more than three layers, the chart will give an approximate value only, when value is multiplied by the square of the number of layers.

To find the dimensions of a coil for a predetermined inductance, find out how many turns of the sized wire to be used can be wound in an inch. Set these values opposite on scales. The index arrow will point directly to the various combinations of length and diameters that can be used.

WAVE LENGTH DETERMINATION USING COMPUTER

On the reverse side of the Inductance coil design card, scales will be found which may be used to determine resonance wave-length for a given inductance (in millihenries) and capacity (in microfarads). Set the disc so that the values for these quantities are opposite each other. The index arrow will then point directly to the wave-length in meters.

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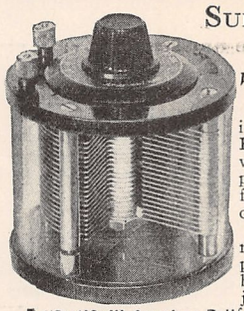

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A wonderful instrument of mechanical perfection. Endorsed by radio engineers, journals and fans, from all over the U.S. A trial will mean a most marvelous surprise to you in radio satisfaction.

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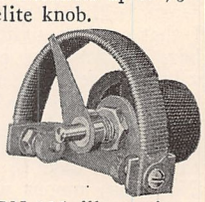

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Resistance 6 ohms	
RS-108	.85
Resistance 3 ohms	
RS-109	1.25
Resistance 20 ohms (Potentiometer)	
PS-604	1.75
Resistance 250 ohms	

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DAVID KILLOCH COMPANY
57 Murray Street New York City

If the wave-length is known and either the capacity or the inductance, the unknown value may be determined by reverse procedure.

I Want to Know

(*Continued from page* 54)

CONDENSERS IN SERIES

(715) Mr. C. L. Fisher, Maryville, Mo., asks:

Q. 1. Will two variable condensers each having a capacity of .001 mfd., when hooked in series, equal a variable condenser with a capacity of .002 mfd.?

A. 1. The two condensers would have to be placed in parallel if it is desired to combine their capacities. When connected in series, the total capacity would be .0005 mfd.

Q. 2. Can a variable condenser with a capacity of .002 be purchased, and, if so, where?

A. 2. A variable condenser of this size may be obtained from the General Radio Co., Cambridge, Mass.

BEVERAGE ANTENNA

(716) Mr. Frank L. Cudley, Durant, Miss., desires:

Q. 1. Please publish data for a Beverage antenna for 200- to 600-meter reception.

A. 1. A Beverage antenna should be at least one wave-length long. Thus, for 200-meter reception, an antenna of about 660′ long is required. This should point in the direction from which the desired signal is to be received. The far-end of the antenna should be grounded through a non-inductive resistance of about 550 ohms. For 600-meter reception, an antenna of at least 2,000′ long would be necessary. As this type of antenna is very directional, it is not recommended for general use.

Q. 2. Is the super-heterodyne receiver superior to other receivers for phone reception?

A. 2. This receiver is conceded to be the most efficient for both code and phone.

CRYSTAL SET RANGE

(717) Mr. Chas. Bessey, Zanesville, Ohio, wants to know:

Q. 1. Please give the average range of a crystal set consisting of a loose coupler, crystal, variable condenser and loading coil.

A. 1. The range of any receiving set depends upon the power of the transmitting stations. A crystal set is usually conceded a receiving range of about 30 miles, but when receiving the high-power broadcasting stations, sending today, a distance of 100 or 200 miles can be covered under good conditions.

Q. 2. Do the plugs that screw into an electric socket, to take the place of an antenna, give satisfactory results?

A. 2. Although these plugs are not as efficient as a good antenna, the results obtained are, as a rule, very good.

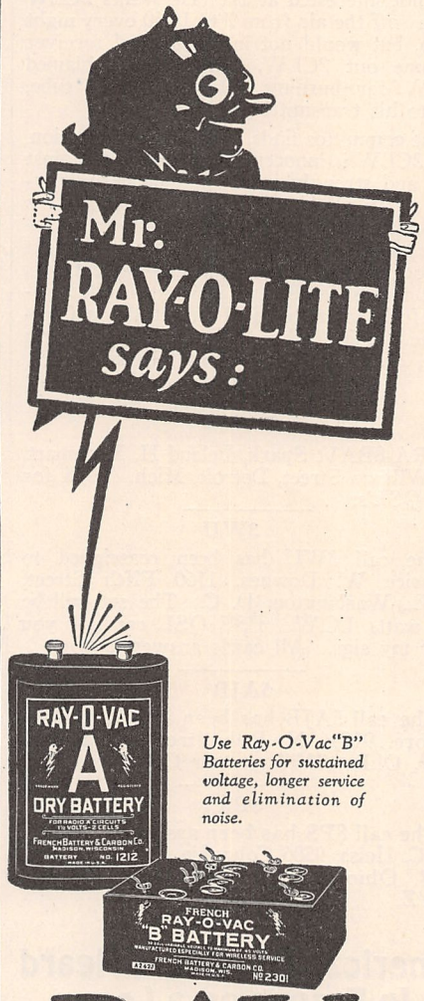
Amateurs Probe QRM Complaint and Find Trouble

(*Continued from page* 42)

on your referring the above case to this club, investigated this matter on the 2d instant. Their report follows:

"The committee, 2PF, 2AUZ, and 2KE visited Robert Steffens, 2CLW, 100 Warwick Street, Brooklyn. His transmitter consisted of two five-watt UV202's, Acme industance, plate voltage 500 volt D. C. motor enerator, filter, two 2-mfd. W.E. condensers, Acme choke coil, ammeter, volt-meter, etc., no chopper or microphone. Transmitter mounted on wooden base. Radiation, 2.3 amps.; wave as checked by wavemeter 202 meters. Using Hartley circuit. Nine wire counterpoise with tuned ground. The committee could not improve upon the transmitter.

"Mr. M. Cook, 82 Barbey Street, the complaining BCL, was next visited. His receiver consisted of: variocoupler, forty-three-plate variable condenser, WD-11 tube, socket, etc. All mounted upon a hard rubber panel with controls in front. Antenna is a two-wire about eighty feet long. WJZ and WEAF come in QSA, but when 2CLW was ransmitting his D. C. clicks could be heard all over the tuner, and tuning with the condenser made no difference. 2AUZ then hooked up his Reinartz, using one J tube



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Everyone interested in radio should have the Ray-O-Vac Radio Trouble Finder and Broadcasting Station Directory. It's free. Send for it today.

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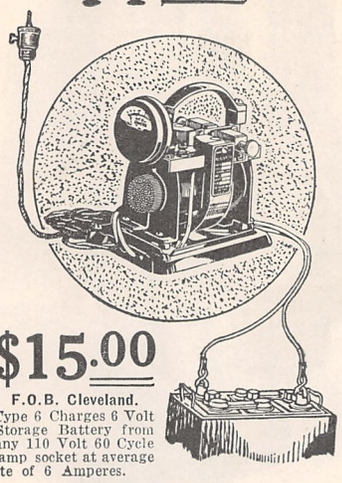

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and the difference was noticed immediately. WJZ and WEAF came in much louder, and 2CLW could not be heard on 360 meters at all!

"As the BCL was using the single circuit hook-up he was unable to tune out 2CLW, or any other QRM. Mr. Cook admitted his receiver was at fault, but refused to spend any money upon its improvement. 2PF then showed him how to change his receiver into a double circuit tuner by changing a few connections, but Mr. Cook was not interested at all. He wants 2CLW to stay off the air from 7 to 10.30 every night or so, but would not install a good receiver to tune out 2CLW. In fact, he blamed 2CLW for burning out his WD-11 tube, due to his transmitting."

The committee finds, from its investigation, that 2CLW is innocent of the charge against him, and strongly urges that he be exonerated from all blame in this matter, as his transmitter was within the law in every respect, and recommends that Mr. Cook get a good receiver, or remake his present one, as it is his receiver that is at fault. Respectfully submitted RM Investigation Committee, David Talley, 2PF, chairman, Joseph Dale, 2AUZ, and F. Melville Green, 2KE.

—Abstract from the Radio Globe.

8BAV

QRA-8BAV, Spark, Leland H. Krompart, 215 William Street, Detroit, Mich. TNX for any QSL's.

3WU

The call 3WU has been reassigned to Maurice W. Downes, 1160 Fifth Street, N. E., Washington, D. C. The set will be five watts I.C.W. PSE QSL card, if you hear my sigs. All cards answered.

5AJB

The call 5AJB has been issued to Paul Moore, 915½ N. Rob Street, Oklahoma City, Okla. Will answer QSL's.

8PS

The call 8PS has been assigned to Harold C. Heiss, 9506 Columbia Avenue, Cleveland, Ohio, who formerly held the call 8CYZ.

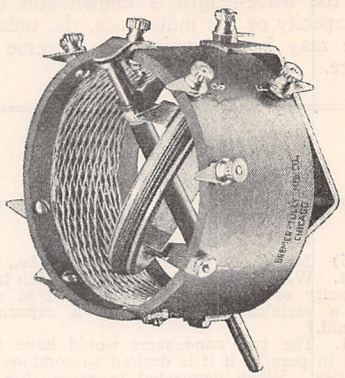
American Amateurs Heard In France on a Loop Receiver.

By J. PLOTARD

Our French Contemporary, Radio-Revue, published in its March number this interesting article, in answer to a question asked recently, on the possibility of receiving American amateur stations with a loop.—Editor.

SEVERAL amateurs recently asked whether it was possible to receive American amateurs with a loop. The answer is positive, as I have succeeded in hearing several stations under the following conditions. For more than one year, I have been experimenting on the reception of short wave-lengths with a loop aerial, but obtained only rather poor results until very recently. So far, I had been able to hear only the English amateur 2AR and Mr. Colman's station, 8AH, near Paris. In fact, it was impossible not to receive Mr. Colman since his signals are very strong.

The loop made at first consisted of one turn of No. 20 wire wound on a frame about 12′ by 7′ and also a section of five turns of No. 24 wire, so as to be able, with a variable condenser of .001 mfd., to tune up to 1100 meters. During February, I changed this loop entirely, and replaced the winding by one turn of insulated cable of seven strands of No. 18 wire insulated. The results were surprising; the same day the loop was completed I heard 12 American amateur stations sending in code, and one in telephony. Unfortunately this last was very



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209 S. State Street Chicago, Ill.

weak and I had to use a separate heterodyne, which chopped the voice very much. The next day, or rather the following morning, since these experiments took place between 2 and 5 a.m., I added another turn on the loop at about 4″ from the first one. Thanks to this added inductance, the English telephone stations came in much stronger; it was possible to hear them on the loud speaker. The intensity of American broadcasting stations was about the same, but the amateur signals were much louder and I received several others in addition to those I had already picked up. It is possible in France to hear a great number of American stations between 11 p.m. and 5 a.m.; unfortunately, on 250 meters one hears the harmonics of all the arc stations in Europe and receiving under these conditions is difficult.

The American stations that come in best are those using I.C.W. or A.C. C.W., as it is possible to follow them through the mush of the arcs. The receiver I used during these experiments consists of three stages of radio frequency amplification with transformer coupling, a detector and two stages of audio frequency, regeneration being obtained by tuning the plate circuit of the detector. The stations heard were as follows: 1MX, very strong, audible at about 12′ from the phones and heard almost every night. 1AD, 2PO, 2ODP, 8AXG, 1ARL, were received three nights in succession; 3AH was also heard on about 275 meters. During two hours a station signing 2AAB called 5NT and sent this telegram: 5MX de 2AAB "report reception if you please" and some V's during five minutes.

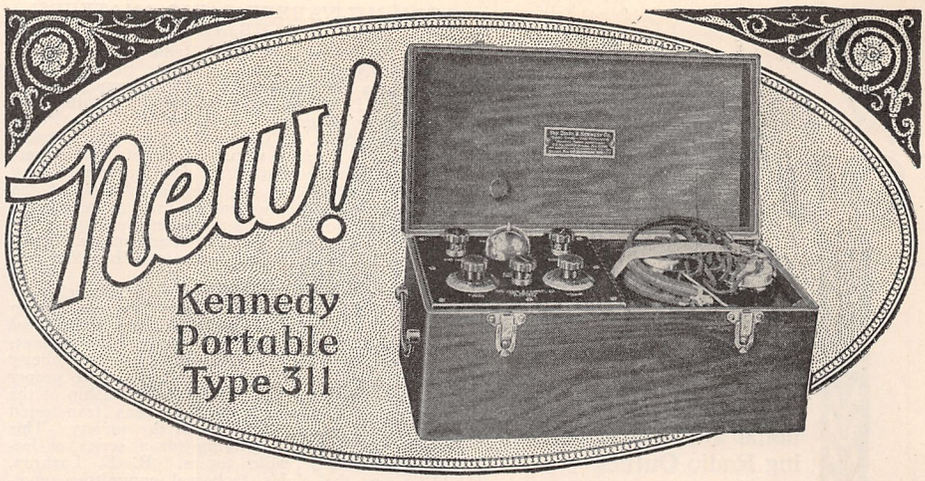
It is rather easy to hear broadcasting stations sending on 360 meters, as this wavelength is free from interference on this side. During these tests I tried to receive the English broadcasting stations, although my loop was fixed and turned in the direction northwest, southeast. To my surprise, I was able to tune in the Cardiff station, which came in louder than the Radiola concerts broadcast with about the same power, only a few miles from my residence. The modulation was absolutely perfect. I also hear very well the Marconi station, 2LO and of course the French broadcasting station of the telephone and telegraph department, which is equipped with a 500-watt Western Electric transmitter, such as is used in the best American broadcasting stations. It is interesting to mention the fact that I replaced my tube detector, which was equipped with an old grid condenser and grid leak by a crystal detector, and the results were improved.

At a certain time Parisian amateurs turned their efforts to eliminate the Eiffel Tower, which came in very strong. Perhaps we will soon have to endeavor *not* to receive the American stations which will cause interference, and then everybody will curse the invention of the vacuum tube and we will have to go back to the crystal or the coherer, unless a new tube with a few dozen electrodes saves us from this terrible situation!

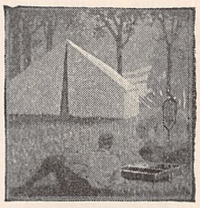
Club Gossip

THE FELLOWCRAFT RADIO CLUB

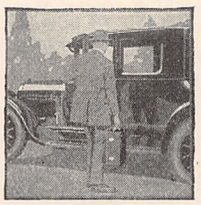
The Fellowcraft Radio Club was founded Jan. 17, 1923. Meetings are held every Wednesday at 4 P. M. in the clubroom. The officers are: President, Bernard Stott, Secretary; Bernard Schultz, and Treasurer, Thomas Fitzgerald. At present we are having a membership drive and are fixing up the clubroom. The object of the club is to promote the art of radio among amateurs and broadcast enthusiasts. Code practice, the reading of papers, and chalk-talks have been started. Anyone between the ages of 12 and 19 may join. The club will appreciate correspondence from other clubs and same will be given immediate attention. Address all mail to the Fellowcraft Radio Club, care of B. Stott, 60 Pallister Ave., Detroit, Mich.



It's Ready—The Ideal Summer Set!



A welcome addition to the camper's kit.



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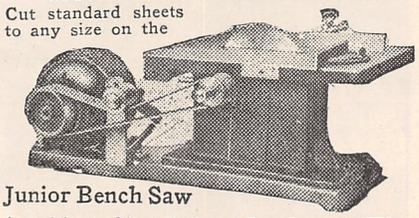

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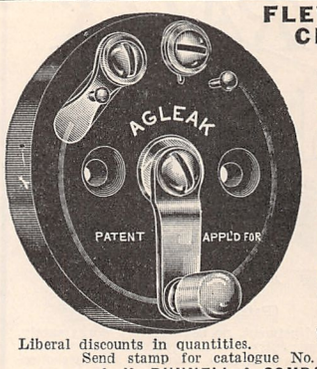

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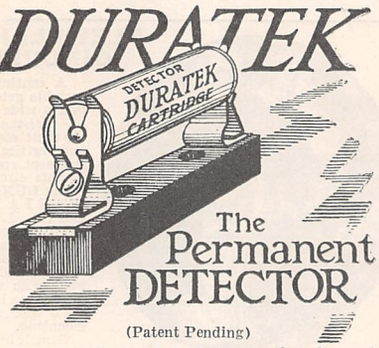

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THE MILWAUKEE RADIO AMATEURS' CLUB, INC.

The Milwaukee Amateurs' Radio Club has been incorporated under the laws of the State of Wisconsin as a non-stock body, and its name changed to The Milwaukee Radio Amateurs' Club, Inc. The incorporators were L. S. Baird, C. N. Crapo, and Attorney L. J. Topolinski, the society's general counsel through whose efforts state incorporation was brought about. In addition to including the past purposes of the club and those of the American Radio Relay League, Inc., the articles of organization provide that the society may own and operate an amateur radio station and may associate itself with the A. R. R. L. as a Milwaukee section or local chapter.

Meetings are continued to be held weekly at 7:45 P. M., Thursdays, in the Trustees' Room of the Milwaukee Public Museum. Business Manager L. S. Baird recently received the appointment as A. R. R. L. Central Division Publicity Manager, and in order that he may devote proper attention to his new duties his chairmanship of the meetings and papers committee was transferred to H. F. Wareing, president of the society. This committee is now arranging for a series of lectures on timely radio topics. R. E. Lathrop, 9ATX, of the club's technical committee represented Wisconsin at the Michigan State A. R. R. L. Convention held at Flint, Mich., and upon his return gave the Milwaukee club members a lengthy report.

Radio frequency amplification has been the subject of several general discussions at meetings, and a short paper entitled "Radio Frequency Intervalve Transformers" was presented by I. H. Strassman, 9AHO. Mr. Strassman, who is A. R. R. L. City Manager, has also reported from time to time the progress being made in ridding the air of unlicensed stations. These offenders have operated much to the discomfort of both the local radiophone listeners and the amateurs.

THE CITIZENS' RADIO CLUB OF ROCKFORD, ILLINOIS

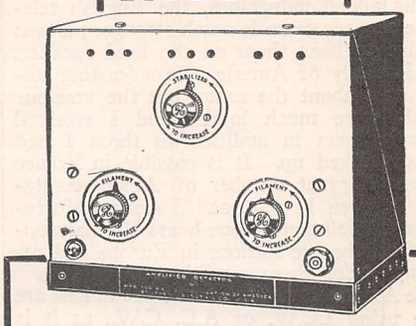
The Citizens' Radio Club, of Rockford, Ill., was organized in January, 1922, at the Rockford Boys' Club. The Club failed to accomplish anything during the warm summer months, but it held a Booster Meeting during the early part of last December, at which time the members made plans for the complete reorganization of the Club. Membership information was broadcast from Radio WIAD, with the result that the Club membership was tripled. The Club has accomplished great results in the way of advising radio embryo fans. On April 6 and 7, the organization put on the first radio show ever held in Rockford. Four of the local radio dealers put on exhibits and there were also exhibits of radio antiques, such as the spark transmitter and one of the old immense loose couplers of the 1915 period. The officers of this Club are: Orville Wisman, President; Kenneth Putz, Vice-President; William Anderson, Secretary; William Lindberg, Treasurer and Publicity Agent. This is their second term of office.

IRVINGTON HIGH SCHOOL RADIO CLUB

This Club has been taking an active part in all of the various functions held at our school since last Christmas. Code classes are held, time signals and weather reports taken for the school, and occasionally radio entertainments are given.

(*Continued on page* 111)

KLAUS RADIO



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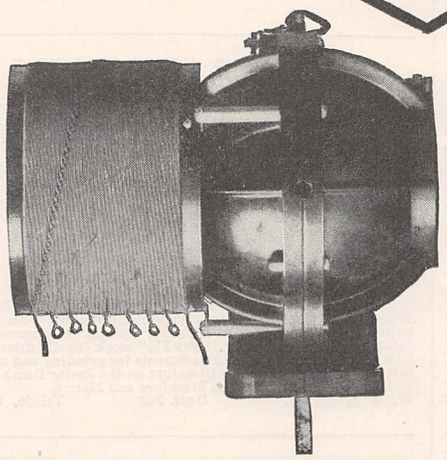

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"BUILD YOUR OWN" WITH "RASCO" PARTS!

THE Radio Specialty Company—"RASCO" for short—now in its third year, is unquestionably the most unique radio parts supply house in the United States, if not in the whole world. This Company makes a specialty of very small orders. No order is too small to get immediate and prompt attention. The reason is simple: 80% of our orders are small.

The reputation of this house was built upon service. Ask any of your radio acquaintances what they think of "RASCO" service, "RASCO" promptness. Thousands upon thousands of unsolicited testimonials are in our files, to prove that we serve the public as it has never been served in radio merchandise before. Be sure to get our great 68-page catalog, containing over 500 different parts. Catalog contains over 300 illustrations.

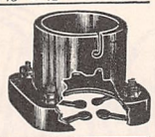
Order direct from this page. All goods sent prepaid in 24 hours. We pay all transportation charges.
Money refunded if goods do not satisfy

RADIO FREQUENCY TRANSFORMERS

The best Radio Frequency Transformer developed so far. Designed for us by Mr. R. E. Lacault, Associate Editor of RADIO NEWS. For wavelengths of 320 to 420 meters. Air core. Guaranteed to do the work. This Transformer brings in the long distances.

R-2800 Radio Frequency Transformer, size 1⅞"x2½" $2.00

VACUUM TUBE SOCKET



Made entirely of composition. Gives no rise to capacity effects, as metal sockets do. Positive contacts.

R-6500, Vacuum Tube Socket .....$.35

ANTENNA CONNECTOR

Made entirely of aluminum. Will not rust. The four wires go to upper holes. Lower hole takes lead-in. Don't solder your aerial. Dimensions, 2" high, 1¾" wide.

R-999. Antenna Connector $.30

MOULDED DIALS

Highest grade made. Brilliant black composition. Figures inlaid in white enamel. For ¼" or 3/16" shaft.

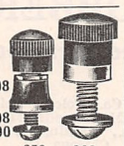
R-3074, Dial, 2½" .....$.55
R-3075, Dial, 3¼" ..... .65
R-3076, Dial 3⅞" ..... .80

FLUTED KNOBS

Made of best black composition, provided with 8/32" bushing. Height 1", Diameter 1¼".

R-2055 Fluted Knob.....$.15

"RASCO" POSTS



R-650, Post made entirely of best black composition—8/32" screw—each .....$.08
R-202, Post has nickel-plated bottom part, each..... .08
Dozen, each style ..... .90

RASCO SWITCH POINTS

Nickel-plated and polished. The following have been found the most popular.

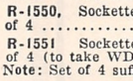
1, ¾"x¼", 6/32" thread, doz.....$.35
2, 3/16" high, ¼" dia., 6/32" thread, doz. ..... .35
3, 3/16"x3/16", 4-36 thread, doz... .35
4, ¼" dia., ⅛" thick; shank 6/32" doz. ..... .40
5, ¼" dia., 3/16" thick; shank 4-36, doz. .40
6, 3/16" dia., 3/16" thick; shank 4-36, doz. .40
7, 3/16" dia., ⅛" thick; shank 4-36, doz. .40
75, Switch Stop ⅞" long, 4-36 thread, complete with nut, each ..... .04
76, New style Switch Point, to be pressed into bakelite panels with forced fit. Wire is soldered to pin end. Head ¼" dia., 1/16" thick, doz. ..... .40
77, same as above, but head is ¼" dia. x 3/16" thick, doz. ..... .40

SOCKETTES

Substitute for Vacuum Tube Socket. Four of these take one Vacuum Tube. Grasp tube firmly. Best contact possible. Take less room. Are better.

R-1550, Sockettes, nickeled, set of 4 .....$.25
R-1551 Sockettes, nickeled, set of 4 (to take WD-11 Tube) ..... .25
Note: Set of 4 sufficient to hold 1 Tube.

VACUUM TUBE FUSES



Insure your tubes against blow outs.

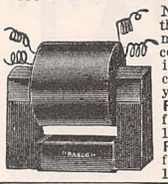
R-2575, Fuse, 1 ampere.....$.15
R-2576, Fuse, 1½ ampere ..... .15
R-2577, Fuse, 2 ampere ..... .15

UNIVERSAL BEARING

THE bearing to hold variometer and variocoupler rotors. Total length of bearing 2¼". Outside shaft, 1¼". Length of thread 1". Length of threaded sleeve, ¾".

R-1375, Bearing .....$.25

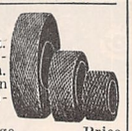
AUDIO FREQUENCY TRANSFORMERS



No better Transformer on the market. Highest class materials. Impregnated coils. Silicon steel stampings used. Save 50 per cent by assembling it yourself.

R-1100, A.F. Transformer, ratio 4¼ to 1 .....$2.65
R-1150, A.F. Transformer, ratio 6½ to 1 ..... 2.65

HONEYCOMB COILS



No better coils on the market. Too well known for lengthy description. Firm impregnation. Range given is in meters when varied with a .001 Variable Condenser:

No.	Turns	Range	Price
R-5000	25	120- 250	$ .40
R-5001	35	175- 450	.45
R-5002	50	240- 720	.50
R-5003	75	390- 910	.55
R-5004	100	500- 1450	.60
R-5005	150	600- 2000	.65
R-5006	200	900- 2500	.75
R-5007	250	1200- 3500	.80
R-5008	300	1500- 4500	.85
R-5009	400	2000- 5000	1.00
R-5010	500	2800- 6100	1.15
R-5011	600	4000-10000	1.30
R-5012	750	5000-12000	1.45
R-5013	1000	7900-15000	1.70
R-5014	1250	9750-19500	1.95
R-5015	1500	14500-26500	2.20

CORD TIP JACKS

Take the place of binding posts on instruments or panel. Cord tip firmly gripped by jack. Made of brass, highly nickel-plated and polished. Screw to attach lead wire. No soldering necessary.

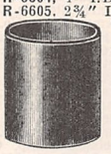
R-1500, Cord Tip Jack, each.....$.15

CARDBOARD TUBING

Only seamless tubing made in United States. Perfectly seasoned. Heavy wall. (I.D.—Inside Diameter. O.D.—Outside Diameter. L.—Length).

R-6600, 3" I.D., 3¼" O.D. x 7" L. .....$.30
R-6601, 3½" I.D., 3¾" O.D. x 7" L..... .35
R-6602, 3¼" I.D., 3½" O.D. x 5" L..... .25
R-6603, 3¾" I.D., 4" O.D. x 5" L..... .27
R-6604, 4" I.D., 4¼" O.D. x 5" L..... .35
R-6605, 2¾" I.D. 3" O.D. x 2⅜" L..... .15

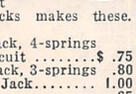
MICANITE TUBING



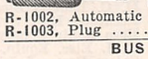
Especially suitable for CW work Nothing better made. Natural color.

R-250, Micanite Tubing, 4" dia., 6" long $1.20
R-251, Micanite Tubing, 6" dia., 6" long 1.60

JACKS AND PLUGS

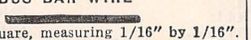


Best material. Only pure silver contacts used. Factory that makes Postal Telegraph jacks makes these. This is your guarantee.



R-1000, Jack, 4-springs double circuit .....$ .75
R-1001, Jack, 3-springs .80
R-1002, Automatic 5-spring Jack..... 1.00
R-1003, Plug ..... .65

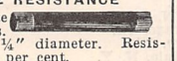
BUS BAR WIRE



This wire is square, measuring 1/16" by 1/16". Easy to solder as it is already tinned. Used on all up-to-date instruments. Sold in 2-foot lengths only.

R-6400 Bus Bar Wire, per 2-foot length..$.05

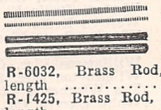
NON-INDUCTIVE RESISTANCE



Made of special graphite copper-plated at the ends. Round rods 1¾" long, ¼" diameter. Resistance accurate within 20 per cent.

R-5300 Resistance 12,000 ohms.....$.65
R-5301, Resistance 70,000 ohms..... .65

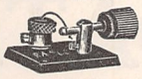
BRASS RODS



Sold in 6" lengths only

R-8032, Brass Rod, 8/32" thread, per length .....$.08
R-6032, Brass Rod, 6/32" thread, per length ..... .06
R-1425, Brass Rod, plain ¼" round, per length ..... .40
R-3616 Brass Rod, plain 3/16" round, per length ..... .06

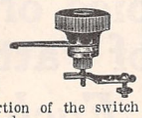
"RASCO" BABY DETECTOR



Base is solid black composition; mounted on same is nickel holder and binding post, which holds the fluted hard rubber knob with its sliding rod member. Patent nickel detector cup and binding post. Patent cup holds crystal.

R-1898, Baby Detector, with Galena .....$.50

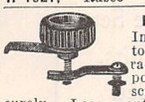
"RASCO" LUBRICATED PANEL SWITCH



Our patent spring fork holds the switch handle always at a uniform tension. At the same time it insures best contact possible. New wiping contact covers every portion of the switch point. Double leaf blades used.

R-1921, "Rasco" Switch .....$.40

PANEL SWITCH LEVER



Imposible for this lever not to make positive contact. Leg radius 1¼". Nickel-plated and polished. Lock fork holds the screw (in which it rotates) securely. Loose contact impossible.

R-200, Switch Lever .....$.30

"RASCO" NAME PLATES

The circular plate is our new Binding Post Name Plate. Diameter, ¾". These denominations: PHONES, GROUND, —, OUTPUT, "A" BATTERY —, "B" BATTERY—, LOUD SPEAKER, GRID, LOAD, "C"BATTERY—,AERIAL, +, INPUT, "A" BATTERY+ "B" BATTERY +, LOOP, TICKLER, PLATE, "C" BATTERY +, FILAMENT.

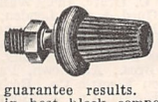
R-6000 to 6019, Binding Post Name Plates, each denomination .....$.03
Dozen ..... .30

Square Name Plates

Same denominations as above also these:SERIES 1st STEP, 2nd STEP, 3rd STEP, SECONDARY CONDENSER, TELEPHONE, SECONDARY, DETECTOR, TRANSMIT, GRID VARIOMETER, PARALLEL, COUPLING, PRIMARY, LOADING COIL, RECEIVE, ANTENNA, PLATE VARIOMTER, "BLANK", AUDION, ON, OFF.

R-834 to 866, Square Name Plates, each..$.04
Dozen ..... .40
R-839 "INCREASE CURRENT" (Right)
R-840 "INCREASE CURRENT" (Left)
Each ..... .10

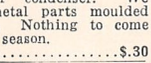
VERNIER



Cleverest vernier made. Can be used with any dial. Soft rubber ring engages dial. Does away with vernier condenser. We guarantee results. All metal parts moulded in best black composition. Nothing to come apart. Biggest hit of the season.

R-1450, Vernier .....$.30

"RASCO" CONDENSERS



R-5050, Phone Condensers, each.....$.20
R-5056, Grid Condensers, each..... .20
R-5059, Grid Leak Condensers, each ..... .30

COPPER FOIL

Thinnest copper foil made, .001" thick. Comes 4" wide.

R-5025, Copper Foil, per ft. $.10
10-ft. length ..... .80

RADIO CEMENT

Weather resisting. Used particularly for cementing covered wires. Coils covered with this cement require no form. Wires hold together solely with this cement.

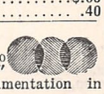
R-1750, Cement, 2-oz. bottle $.50

TELEPHONE SHELL AND CAP

For the experimenter we list this composition shell and cap. No holes in shell whatsoever. Takes standard 2⅛" diaphragm.

R-2700, Shell-and-Cap, complete .....$.65
R-2701, Shell only ..... .40

MICA DIAPHRAGMS



Made of special India mica in two sizes, 2⅛" diameter and 1-13/16" diameter. Excellent for experimentation in telephone work.

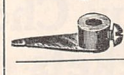
R-2550, Diaphragm, 2⅛" .....$.20
R-2551, Diaphragm, 1-13/16" ..... .15

RHEOSTAT WINDINGS

These windings, with the switch arm shown below, constitute a complete rheostat for the experimenter. Resistance wound on flexible black fibre. Carries 1½ amperes, resistance 6 ohms.

R-4300, Rheostat Resistance each .....$.20
R-4301, Potentiometer Resistance, each (200 ohms) .. .35

BLADE WITH COLLAR



Fits above.

R-1675, each .....$.10

MAGNET WIRE

We list only best qualities. "DCC" means Double Cotton Covered. "GS" means Green Silk. "E" stands for Enameled. The following come on 8-ounce spools:

R-2500, DCC No. 18.....$ .50
R-2501, DCC No. 20..... .60
R-2502, DCC No. 22..... .75
R-2503, DCC No. 24..... .85
R-2504, DCC No. 26..... .95
R-2505, DCC No. 28..... 1.15
R-2506, DCC No. 30..... 1.65

The following come on 4-ounce spools:

R-2507, GS No. 20.....$ .50
R-2508, GS No. 22..... .55
R-2509, GS No. 24..... .60
R-2510, GS No. 26..... .65
R-2511, GS No. 30..... 1.05
R-2512, GS No. 32..... 1.30
R-2513 GS No. 36..... 1.85

The following come on 8-ounce spools:

R-2514, E No. 20.....$ .45
R-2515, E No. 22..... .55
R-2516, E No. 24..... .60
R-2517, E No. 26..... .65
R-2518, E No. 30..... .70
R-2519, E No. 32..... .80
R-2520, E No. 36..... 1.00

LITZ WIRE

R-323, equals No. 25 B&S, per foot .....$.02
R-890, equals No. 28 B&S, per foot ..... .01
R-891, equals No. 21 B&S, per foot ..... .03
R-892, equals No. 20 B&S per foot ..... .04
R-893, equals No. 14 B&S, per foot ..... .12

Discounts of 10 per cent in 100-foot lots.

The "Rasco" Catalog

CONTAINS 75 VACUUM TUBE HOOK-UPS, 300 ILLUSTRATIONS
500 ARTICLES, 68 PAGES

All Armstrong Circuits: These important circuits are explained clearly, all values having been given leaving out nothing that could puzzle you.

Just to name a few of the Vacuum Tube circuits: The V.T. as a detector and one-step amplifier; Armstrong circuits; one-step radio frequency amplifier and detector; three stage audio - frequency amplifier; short wave regenerative circuits; 4-stage radio frequency amplifiers; radio and audio frequency amplifier; inductively coupled amplifier; Armstrong superautodyne; radio frequency amplifier and crystal detector; combination V.T. detector one stage amplifier; two stage radio frequency amplifier and detector with feedback coupling (regenerative); regenerative receiver, using single spider web coil; Armstrong super-regenerative circuit; two stage radio frequency amplifier coupled to a two-circuit tuner, using two-slide tuner regenerative receiver; two stage audio-frequency amplifier, using crystal or V.T.; one stage radio frequency detector, two stages audio-frequency with feed-back coupling to first tube; power amplifier with loud speaker; regenerative receiver and one stage amplifier for DX work; one stage radio frequency detector with feed-back coupling; three stages radio frequency, two stages audio-frequency loop reception; crystal detector with rectification; one tube super-regenerative receiver; short wave regenerative receiver with two variocouplers, capacity-coupled tuner; trap circuit to eliminate interference; selective circuit to eliminate interference The catalog contains 300 illustrations. On account of its great cost, it cannot be distributed free of charge. Mailed only upon receipt of

15 Cents in Stamps or Coin.

This business was originated with the sole idea in mind to cater to the radio amateur who has small orders. ALL OF OUR ORDERS ARE SMALL. THAT IS WHY YOUR SMALL ORDER CAN NEVER BE SIDE-TRACKED BY US. A trial order will make you a life customer. Order from the above illustrations. 24-hour service guaranteed. "WE CAN ONLY DISAPPOINT YOU ONCE." Try us with a 50c. order and make us prove what we say. Prices include delivery to your door.

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Oldest and Original Exclusive Radio Parts House in U. S.

Factories: Brooklyn, N. Y. — Elkridge, Md.

DEALERS
Get Our Special Proposition

You Can Build Your Own Radio Apparatus

As Easily as a Woman Makes a Dress!

ASK FOR

"CONSOLIDATED" PATTERNS

Your Choice of Six Packets of Patterns

50c. Each

How to make a Short Wave Regenerative Set.

How to make Detector and Amplifier Units.

How to make a Radio Phone Crystal Set.

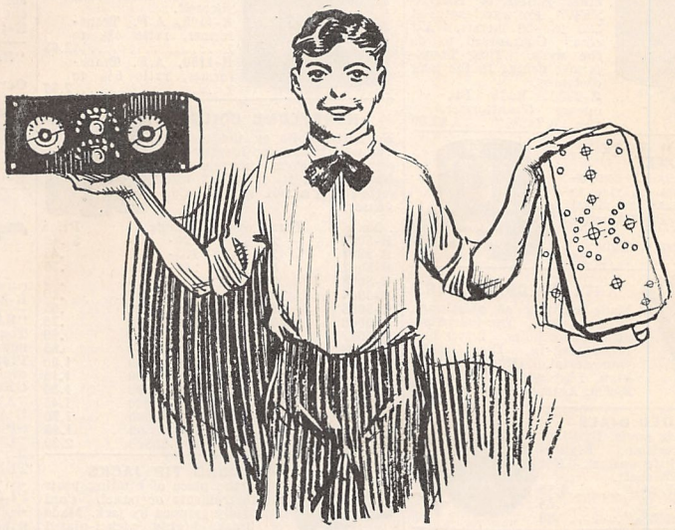
20 Radiophone Diagrams and Hook-ups.

14 Radio Formulae and Diagrams.

All About Aerials.

Each Packet Contains

Illustrated Directions, List of Parts Required, Detailed Wiring Diagram and Full Size Panel Drilling Template



For sale everywhere in the United States and eleven foreign countries

GO TO YOUR NEAREST DEALER OR JOBBER

There's not space enough to list them all. But here are a few firms who carry our line

(*More names of our dealers in your town furnished on request*)

Alamo Sales Corp., Indianapolis, Ind.
Albany Radio Corp., Albany, N. Y.
Allied Radio Co., N. Y. C.
Harry Alter & Co., Chicago, Ill.
Julius Andrae & Co., Milwaukee, Wis.
Jacob Andressen Co., Minneapolis, Minn.
American News Co., N. Y. C.
Atlantic Radio Co., Boston, Mass.
Bamberger & Co., Newark, N. J.
Bannister & Pollard Co., Newark, N. J.
Barawick Co., Chicago, Ill.
Jos. A. Becker, Baltimore, Md.
Beckley-Ralston Co., Chicago, Ill.
J. Belmuth, N. Y. C.
The Benwood Co., St. Louis, Mo.
Brooklyn Radio Service Co., Brooklyn, N. Y.
J. H. Bunnell & Co., N. Y. C.
Butler Bros., N. Y. C.
Capital Elec. Co., Atlanta, Ga.
Capital Radio Supply Co., Indianapolis, Ind.
Carnahan & Dalzell, Inc., N. Y. C.
Geo. H. Chase, Newport, R. I.
Chicago Radio Apparatus Co., Chicago, Ill.
Clapp-Eastham Co., Cambridge, Mass.
L. M. Cleveland Co., Portland, Me.
Continental Radio & Elec. Sup. Co., N. Y. C.
Cutter & Wood Supply Co., Boston, Mass.
Detroit Elec. Co., Detroit, Mich.
Delaney-Felch & Co., Pawtucket, R. I.
Dewey Sporting Goods Co., Milwaukee, Wis.
Doubleday-Hill Co., Pittsburgh, Pa.
T. Eaton Co., Ltd., Winnepeg, Can.
Elec. Appliance Co., Chicago, Ill.
The Elec. Shop, New Brunswick, N. J.
Elec. Supply & Equipment Co., Hartford, Conn.
Elliott Elec. Co., Cleveland, Ohio.
Fairbanks Elec. Co., Stamford, Conn.
Federal Elec. Supply Co., Detroit, Mich.
Federal Radio & Elec. Co., Paterson, N. J.
Fenno & Co., N. Y. C.
Fergus Elec. Co., Zanesville, Ohio.
Findley Elec. Supply Co., Minneapolis, Minn.
Fleron & Sons, Trenton, N. J.
Frank Radio Co., N. Y. C.
Fremont Radio Co., N. Y. C.
Fuetterer Battery Service, St. Louis, Mo.
Seth Fuller Co., Boston, Mass.
Gain-a-day Elec. Co., Pittsburgh, Pa.
Galveston Wireless Supply Co., Galveston, Texas
Gardner Hardware Co., Gardner, Mass.
Gee Elec. Co., Wheeling, W. Va.
Gimbel Bros., Philadelphia, Pa.
Goldsmith & Sons Co., Pittsburgh, Pa.
Great Bend Radio Elec. Co., Great Bend, Kan.
Harry C. Grove, Inc., Washington, D. C.
Wm. Gurd & Co., London, Ont., Can.
Hall Electric Co., Columbus, Ohio.
Hatfield Elec. Co., Indianapolis, Ind.
Havens Elec. Co., Albany, N. Y.
Hess Bros., Allentown, Pa.
Hickson Electric Co., Rochester, N. Y.
Holt Electric Co., Jacksonville, Fla.
Ludwig Hommel & Co., Pittsburgh, Pa.
Huey & Philip Hdwe. Co., Dallas, Texas.
Hughes Elec. Corp., Syracuse, N. Y.
Ignition Service Supply Co., Albany, N. Y.
Inland Electric Co., Chicago, Ill.
International Radio Corp., Boston, Mass.
Interstate Elec. Co., Birmingham, Ala.
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NOTICE TO DEALERS—YOUR name can be listed in the next issue—ASK US HOW!

A column is conducted in the local paper and numerous technical articles published therein. The Club is contemplating a radio dance, to be held soon. In a coming Science show, some interesting exhibits are to be put out for inspection. The officers of the Club are: Edward Shultz, President; Elmer Lee, Secretary and Treasurer; and Mr. Chamberlain, Faculty Adviser. The Club also has a number of committees, such as the Electrical, Paper, Library, Entertainment, Membership, Emblem and Constitution Committee.

THE SOUTH HIGH RADIO CLUB

The South High Radio Club, at South High School, Cleveland, O., has started a new membership drive, under the direction of G. C. Mathersbaugh, Professor of Physics. The Club has 75 members and an Executive Committee, consisting of Alfred Kies, Joseph Pimowar and James Kasgubski, Publicity Manager. Our equipment consists of a Grebe CR-5, with a two-stage amplifier. Storage "B" batteries are used, and an "A" storage battery, of the Edison type. Meetings are held every Wednesday, at 9:00 A. M. and 3:00 P. M.

THE STANFORD HIGH SCHOOL RADIO CLUB

The Stanford High School Radio Club was organized April 17, 1923, for the purpose of increasing interest in radio among the students.

The following officers were elected: President, Wm. W. Sutliff; Vice-President, Miss Louise Perrone; Secretary, Clarence Ough; and Treasurer, E. Myers.

The following three committees will soon be appointed: Social, Program, and Finance committees.

The club is honored by having in its membership several young ladies, one of whom is vice-president.

One of the members of the club is the owner of the famous 6 BGM station.

A complete set of C.W. transmitting and receiving apparatus will be installed in the Science room of the school.

Anyone who wishes to correspond with us should address the Secretary at 4141 Fourth Avenue, Sacramento, California.

THE CAPITAL DISTRICT RADIO CLUB

The Capital District Radio Club, located at Waterford, N. Y., was formed for the object of giving the novices in and around Waterford the advice and experience of the older and more experienced radio fans. The officers of the Club are: Mr. Galvin, President; Mr. Conor, 1st Vice-President; Mr. Mead, 2nd Vice-President; Mr. Ridings, Secretary; Mr. Courtney, Treasurer; and Mr. Elmendorf, Publicity Agent. The Club has very fine rooms, and space has been made for an experimental table and a number of sets, so that any members of the Club can try out new circuits, or experiment with home-made sets, whenever they so desire. The aerial used for these purposes is 270′ at its highest point. Since the organization of this Club, regular code classes have been carried on. The instructor, Mr. King, one of the Club members, gives his services without charge, and thus the Club offers a fine opportunity to its members to learn the code without expense. The Club intends to have a number of its members efficient in the way of sending and receiving by code, so that, when joining the American Radio Relay League, there will be no difficulty in efficiently handling any traffic passing through Waterford. The Club also gives lessons in the history of radio. This course is not detailed, but just enough instruction is given so that a person can learn what he is doing when he turns a knob, or adds another part to his set. It has been our object to make this a mutual benefit club, and to this end we should like to hear from all who may be interested concerning its aims and definite object. Address all communications to Mr. Elmendorf, Waterford, N. Y.

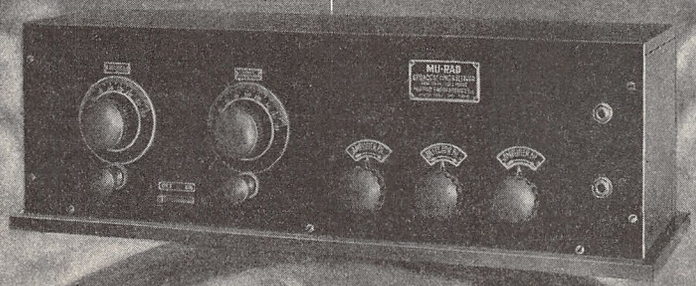
GERMAN RADIO CLUB

We are informed that a German radio club was organized recently by a great number of Berlin technicians and amateurs. The radio summons by which the German Post Office and Duke Arco recently, by public presentation, attracted the attention of each and every one has accordingly reached its goal. Besides more than two hundred who were personally present, 300 interested people in the one province have given their approval. As results of the convocation, the following summary may be given:

The Deutscher Radioclub shall guard particularly the interests of the German radio amateurs and build them up as far as the relations of the general radio interests towards the authorities permit. Based on the lectures of Dr. Nesper and Dr. Loewe, the wish has been expressed by the circle of manufacturers, selling companies, and amateurs, to call into being at an early period a second Radiospark association with one or more sending stations, and it has been determined to obtain this concession from the Post Office and in this way to be able to conserve and carry out the unachieved desires of traveling men, bankers, newspapers, industrial concerns, agricultural associations, Chambers of Commerce, as well as the interests of amateurs.

In almost all cultivated countries there are now numberless private associations and clubs owning private sending stations for general news and concerts. Foreign technicians believe that Germany can now undertake the necessary steps and can establish and carry out in this direction the re-

MU-RAD RECEIVERS SUPREME



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HOW TO BUILD THEM

By H. WINFIELD SECOR

Associate Editor of Science & Invention

This book describes how to build two distinct and different types of radio loud-talkers, which can be built with either electro-magnetic field to be excited from storage battery, as well as permanent magnet field requiring no separate battery excitation. The third chapter deals with improvised loud-talkers and gives clear and complete instructions on how to build suitable horns for use with radio receivers of the Baldwin and other types. Several elaborate hook-ups are given of the author's own radio receiving set, comprising one stage of radio-frequency, detector and three stages of audio-frequency amplification, together with all the connections for the loud-talker.

Complete data is given for all the parts of the loud-talkers, including the field magnet windings, as well as the diaphragm or moving coil windings, and also the step-down transformer to be connected between the vacuum tube amplifier and the loud-talker proper.

In preparing these designs the point has been constantly kept in mind to use the simplest parts possible, so that practically anyone can build a successful loud-talker equivalent to the commercial types costing $40.00 or more.

64 pages, 25 illustrations, bound in beautiful two-color cover, size 5½ x 7½ in.; Price prepaid **25c**

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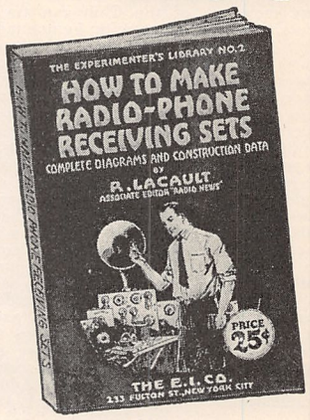

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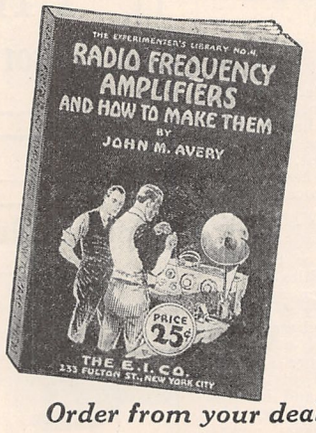

This book is for the more advanced amateur, showing the construction of the Radio Frequency Amplifying Transformer and giving complete constructional data. It shows the application of Radio Frequency to amplifying units that the amateur may already possess and gives 15 hook-ups showing practically every use Radio Frequency Amplifying Transformers can be put to.

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sults of all the experiences of her foreign neighbors. News of every sort will undoubtedly, in the near future, obtain a great expansion as regards its transmission by broadcasting, and here especially the youths of the country, who according to the expression of the present Imperial Chancellor form the future hope of Germany, will find a new field of activity.

When we consider that in Germany, up to date, only a single private stock company, with a capital of 100,000 marks, holds the monopoly for broadcasting, it is felt no doubt that this compact group of Germany radio clubs can get a concession from the Post Office, that is to say, a monopoly for the erection of a second private broadcasting station. The German Radioclub has its club rooms in Berlin, C. 2.

ADAMS COUNTY RADIO CLUB

A radio club under the name of Adams County Radio Club has been organized in Gettysburg, Pa. The following officers were elected: President, Earl G. Ports, operator of Station 3BHY, Gettysburg College; Vice-President, G. E. Slaybaugh; Secretary-Treasurer, H. W. Baker, operator of Station 3CBJ, Gettysburg, Pa.

The Club will hold weekly meetings in the Physics Lecture Room of Gettysburg College. Papers by various members will be read, code instruction given, study and design of radio apparatus, and other problems of importance in radio work will be among the activities of the organization. The two radio telephone stations operated by members of the Club, 3BHY with 50-watt power and 3CBJ with 10-watt power will be used to further club activities. The Club would be pleased to have reports from fellows hearing these stations.

THE MILWAUKEE RADIO AMATEURS' CLUB, INC.

Before an audience of over 500 people, many of them being broadcast listeners, the Milwaukee Radio Amateurs' Club, Inc., recently exhibited the two-reel radio film, "The Wizardry of Wireless." Following the exhibition, A. R. R. L. City Manager I. H. Strassman, 9AHO, and E. T. Howell, Sc., M., technical committee chairman, addressed the gathering on the subject of the relations between the amateurs and the radiophone people. The progress that was being made in ridding the air of unlicensed stations was spoken of, and the efforts of the traffic committee to bring about favorable feelings between the two classes was called to the assembly's attention as well as a description given of that committee's work.

"Radio-Frequency Amplification Systems" was the title of a paper presented by E. D. Nunn, ex-9FE, a Milwaukee radio engineer, in which stress was laid on the use of radio-frequency amplification with two variometer receptors. This lecture is the first of a series being arranged by the new program committee chairman, H. F. Wareing, pre-war 9AEX, and president of the society. H. P. S. Day, Sc.B., a telephone engineer, presented the second, its title being "Vacuum Tube Characteristics," and in non-technical language the fundamentals as well as some of the applications of the thermionic valve were treated in an interesting fashion.

Upon his return from California, Charles S. Polacheck, a former secretary-treasurer, addressed the members under the title of "Some Experiences of a Wayfaring 'Ham' in the West" and told of his meeting with one of the speakers at the club last year, L. E. Grogan, formerly radio engineer to the government of Southern China; also he related his experiences as being a guest of the San Francisco Radio Club, Inc., at several of their lively meetings.

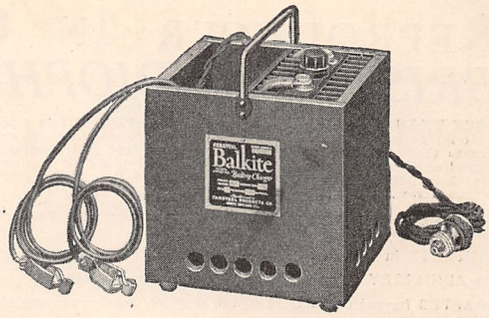
The club's code class for faddists and others is meeting weekly at 7:15 p. m. Thursdays, in the Public Museum Trustees' Room, while the society's regular meetings are held at 8:00 p. m. in the same room and on the same evening.

A Real DX Receiver

(*Continued from page* 43)

of the mounting M1, the D.L. 1500 on the right and the D.L. 1250 on the left. In the same way place the spider-web coils P. S. T. in their respective sockets. The best position for coils D.L. 1250 and 1500 will be found by experiment. It will be such that they form an angle of about 80 degrees with each other. Too small an angle will cause a bad rushing sound in the phones, too great will prevent the tickler from causing regeneration, so a happy medium must be sought.

C4 and C5 in my case are DeForest Vernier Type condensers, and are the tuning elements of the circuit. The adjustment of C1 and C3 once found will vary very little, C1 is usually at Maximum and C3 near the minimum adjustment. Place P at an angle of about 30 degrees to S. Adjust filament of the two valves to near the maximum allowable, set C1 and 3 as above, and gradually bring tickler inwards until on point of caus-



A new battery charger, noiseless and indestructible

The Fansteel Balkite Battery Charger for Radio "A" Batteries is an entirely new type of electrolytic rectifier, based on the use of Fansteel Balkite, a new and rare metal developed for this purpose. It does away with all noise, cannot deteriorate through use or disuse, has nothing to replace, adjust, or get out of order, cannot discharge or short circuit the battery, and requires no attention. There are no moving parts, bulbs, or fuses. It will not overcharge, and cannot fail to operate when connected to the battery and line current. It is unaffected by temperature or fluctuations in line current, and will charge a completely dead battery. It is simple, efficient, and indestructible except through abuse.

FANSTEEL BALKITE is a new metal developed for this charger. It acts as a valve, allowing alternating current to flow into the battery but not out of it. It is the most efficient charger valve made, is practically indestructible, and does away with noisy, delicate vibrators and fragile bulbs.

The Gould Battery Company is also marketing, under the Fansteel Balkite Patents, a complete battery and recharging unit known as the Gould Unipower, into which this charger, under the name, "The Fansteel Balkite Rectifier," has been incorporated.

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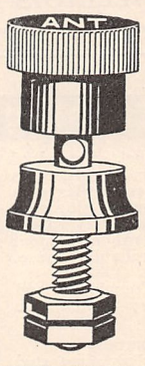

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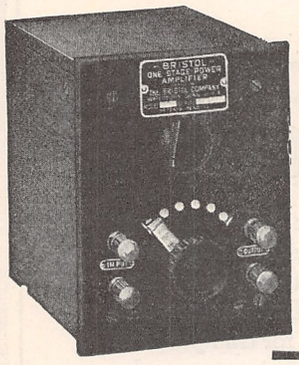

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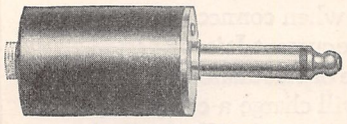

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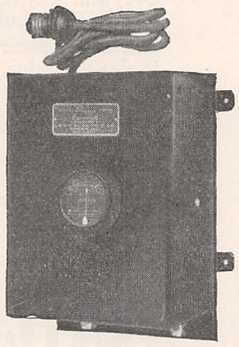

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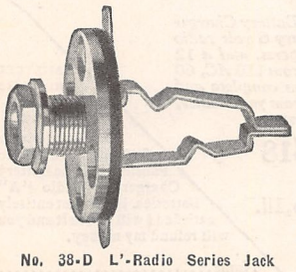

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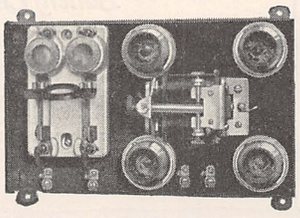

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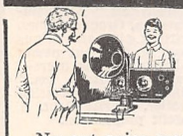

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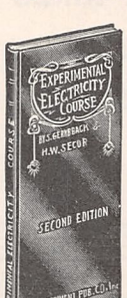

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ing a rushing sound in phones—the test of regeneration. Now open out coils D.L. 1250 and 1500 until they are at such a wide angle that the faint rushing is just on the point of disappearing. Now tune in your nearest broadcasting station and alter all your adjustments, including filament temperature until best position is found. In adjusting, a ripple of C.W. notes coming quickly in and out as the condenser C5 is varied, will be noticed. Having tuned in a station, move knob of C5 towards maximum capacity; should this ripple commence immediately as the knob is moved, add capacity at C2 or alter position of honeycomb coils to make smaller angle until ripple commences about 10 degrees further on from the place where music was received. To aid initial adjustments, the set may be used as a single circuit connected as shown in Fig. 1 by dotted lines. C5 will then be disconnected. Connected in this way the set will interfere with other listeners more. Right here I must say that this set properly adjusted will not reradiate any more than an ordinary regenerative receiver, but do your adjusting when your neighboring fans are in a good mood. In conclusion, I must warn those constructing a similar set not to expect results immediately, but to patiently try different adjustments, different fixed condensers, and, if other valves are used, different values at G.B. (eight volts are good for a W.E. V.T.1). Once you get that ripple of C.W., you are getting near. Even if you are getting good music, and there is still any trace of a C.W. whistle, try different condensers at C1, 2, and 6. If the set will not oscillate, try changing connections to spider-web coils.

Simple Reflex Circuit

(*Continued from page 27*)

coupling to the grid coil, for which honeycomb or spider web coils may be used.

Various types of audio-frequency transformers were tried in this circuit, and all types gave excellent results, although the high ratio transformers, some as high as 10 to 1, seemed to give the best results. Different types of crystal detectors were used, and all proved successful; also different values of fixed condensers were tried, but the values indicated in the diagram gave the best results.

Tuning is accomplished by first tuning in the station with the crystal detector disconnected, thus putting the audio-frequency transformer out of use, except for the fact that the secondary of the transformer is used for a grid leak resistance. Many crystal detectors may be disconnected by simply removing the cat whisker from the crystal. Now the station may be tuned in, the circuit being the same as a single tube regenerative circuit. After tuning in the station to its maximum intensity with the tickler coil placed as close as possible to the grid coil without generating oscillations in the circuit, the crystal detector may be connected, and if adjusted on a sensitive spot, the station will be nearly as loud as before. As the crystal detector circuit absorbs some of the radio-frequency energy from the grid circuit, it will be necessary to move the tickler coil up closer to the grid coil before the tube starts to generate oscillations again. A slight readjustment of the tuning condenser will be necessary after moving the tickler coil. Obviously, more energy is fed back from the plate circuit of the tube to the grid circuit with the closer coupling, and more energy is absorbed in the crystal detector circuit where it is rectified and passed on through the amplifying transformer and impressed on the grid and filament of the tube in the form of audio-frequency energy, where it is amplified by the vacuum tube and made audible in the phones or loudspeaker. The stations will then be received

much louder. In other words, this circuit is equivalent in results to a one-tube regenerative circuit with a one-stage audio frequency amplifier, except that a sensitive crystal is used in place of a vacuum tube for detecting purposes. For DX or loop reception it will be no better than the above set.

As every increase of the received energy builds up a negative charge on the grid, the amplifying transformer should be connected so that it will also impress a negative potential on the grid at the same time. The correct connection is determined by reversing the primary or secondary leads of the transformer and noting which connection gives the best results.

One convenient feature about this circuit is the ease in which comparisons may be made. By removing the crystal, we have a simple one-tube regenerative set. By removing the grid condenser and connecting in the crystal, we have a crystal detector and one-stage audio-frequency amplifier. By connecting in both crystal and grid condenser we have the combination audio and regenerative amplifier.

One phenomenon observed was that when the tickler coil was brought too close to the grid coil, both radio and audio-frequency oscillations were generated in the circuits, the audio-frequency component manifesting itself by a loud howl in the phones. It is interesting to note that when the instruments are adjusted so that the set is just on the verge of howling, it is possible to tune the set to spark or C. W. telegraphy so that every time the telegraph code comes in, the set howls at great intensity. When so adjusted, some of the weakest signals are received with a deafening roar.

Electrons, Electric Waves and Wireless Telephony

(*Continued from page* 19)

thickness. This diaphragm is clamped at the edges between rubber rings, and the speech waves collected by the mouthpiece or trumpet set the disc in vibration, pressing it inwards in concave form to an extent which depends on the amplitude of the sound wave and on the wave form of the latter, or else causing it to bulge out again. Behind this diaphragm is a small flat circular metal box carried on a rigid cross arm. The bottom of this box is covered with a thin disc of hard carbon like a wafer. The lid or top of the box is a thin mica disc, to the inside of which is clamped a similar hard carbon disc. There is a very shallow space between the two carbon discs, which is partly filled with small granules of graphitic carbon or coke (see Fig. 76). Wires are connected to the two carbon discs, and the center of the mica diaphragm is connected by a

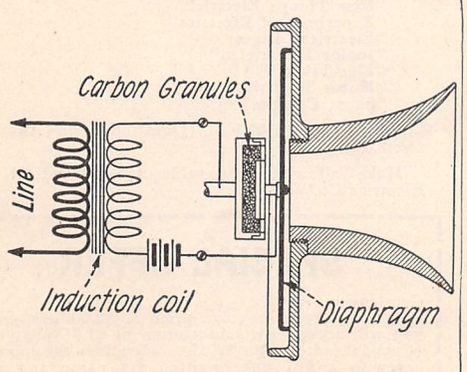
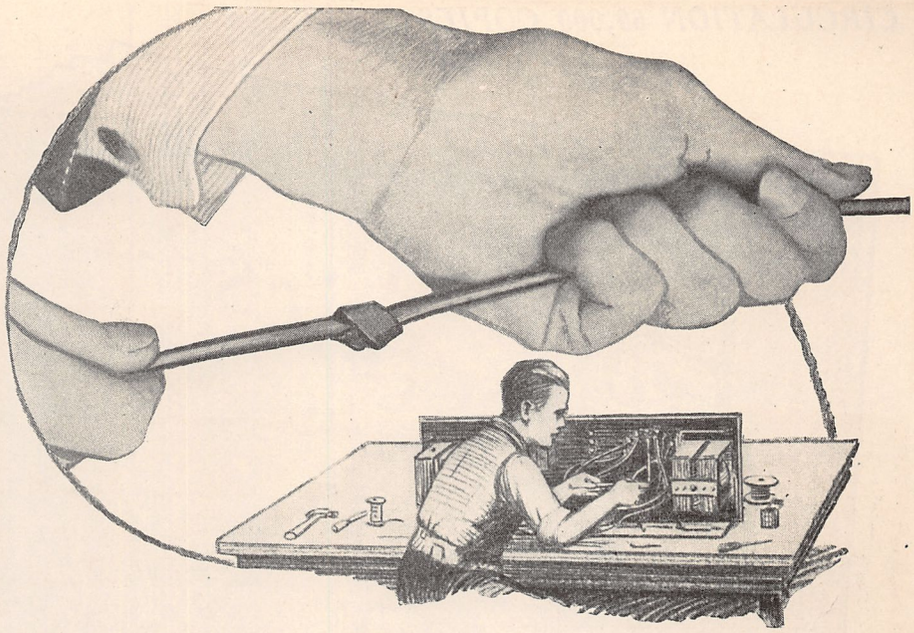


Fig. 76. A Solid-Back Granular Carbon Microphone Transmitter.



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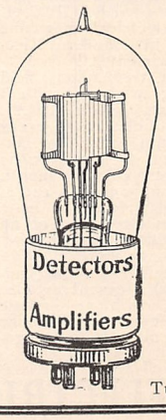

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R. N. 7-23

metal screw with the center of the aluminum diaphragm. Hence, when the latter is set in vibration by the speaking voice it causes a similar movement of the top carbon disc, and the carbon granules are more or less squeezed together, and their electrical resistance varied in the same manner as the movements of the outer diaphragm.

The electrical resistance of the carbon granules may be about 30 ohms in their normal condition, and it falls in resistance under the influence of the compression due to speech waves, but the actual variation of resistance in telephonic work is not more than about 5 to 10 ohms above or below the normal.

Another successful form of carbon transmitter is the Ericsson (see Fig. 77). In this

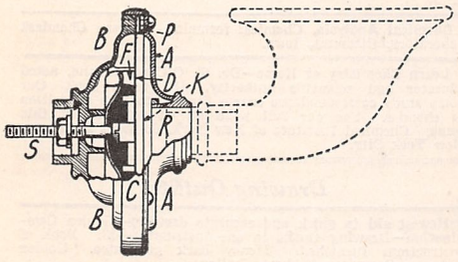

Fig. 77. An Ericsson Carbon Microphone Transmitter.

case the diaphragm which is acted upon by the speech sounds is a thin carbon disc 2.5″ in diameter and 0.04″ in thickness. Behind this diaphragm is a carbon block, and a small interspace between the two is filled with small carbon granules. These are prevented from falling out by means of a ring of felt which encloses the circular carbon block. The normal resistance of this transmitter is 100 ohms, and it varies in operation between 50 and 170 ohms.

A trumpet-shaped mouthpiece is used to collect the sound waves and converge them on the diaphragm, and between the inner end of this trumpet and the carbon diaphragm is a disc of oiled silk to keep the moisture of the breath from entering the microphone chamber. In most carbon granule microphones trouble sometimes arises from the "packing" of the granules, and from the sticking together of these granules, either due to moisture from the breath entering the granule chamber or from heat produced by the current.

The slight compressions due to speech movements of the diaphragm then fail to make the necessary variations in resistance. Great ingenuity has therefore been expended in the invention of liquid microphones, such as those of Q. Majorana and J. Vanni, or by using continually renewed supplies of carbon granules as in the falling carbon powder microphone of Marzi. Nevertheless, the only type of telephone transmitter which has obtained extensive use in practical telephony is the carbon granule microphone.

To be continued.

A MOUTHFUL

Radio manufacturers, seemingly, are lying awake nights, trying to find new names for their products. This is one we actually came across recently:

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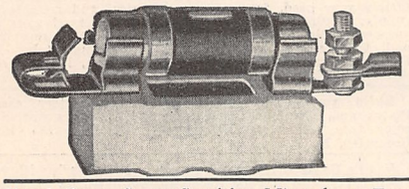

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6x14 Formica Panel	$1.26	$1.10
23 Plate Variable Condenser	3.30	1.45
Three .006 Mica Condensers	3.00	2.25
CRL Variable Grid Leak	1.85	1.35
Remler Grid Leak	.40	.25
2 Coil Adjustable Honeycomb Coil Mounting with Knobs	4.00	2.65
50 Turn Honeycomb Coil	.75	.40
75 Turn Honeycomb Coil	.80	.40
2 Remler Coil Mounts with Straps	1.20	.80
1 Remler Bakelite Socket	1.00	.45
Howard Vernier Rheostat	1.50	1.35
1 Bakelite 3" Dial	1.00	.25
8 Binding Posts	.80	.40
1 Baseboard for Mounting	.30	.20
1 Blueprint with Complete Instructions for Assembly and Wiring	1.00	.50
Regular Price	$22.16	
Our Price		$12.45

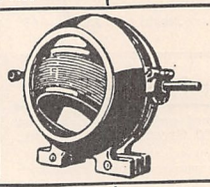
Complete Parts for Ultra Audion Circuit, $11.90
(Known as the Wonder Circuit)

CONSISTING OF	Reg. Price	Our Price
9x10½ Formica Panel	$1.42	$1.20
23-Plate Condenser	3.30	1.45
Bakelite Socket (Remler)	1.00	.45
Special Ultra Audion Coil, plain or bank wound with tape	3.00	1.95
1 Howard Vernier Rheostat	1.50	1.35
CRL Grid Leak	1.50	.95
.0005 Micon Condenser	.35	.25
2 Switch Levers	.70	.50
18 Switch Points	.50	.30
2 Switch Stops	.10	.05
8 Binding Posts	.80	.40
Genuine Solid Mahogany Cabinet, size 9x10½, with hinged top	5.00	2.95
25-ft. Hookup Wire	.20	.10
Regular Price	$19.37	
Our price		$11.90

Each order includes complete instructions for drilling, assembling and wiring. These construction plans are not drawn in a schematic form but are drawn so that any one without any technical knowledge can follow with ease.

U. S. A. SIGNAL CORPS, Aviation Type 194-W WESTERN ELECTRIC PHONES $7.95

Each Phone Cap is covered with large soft rubber ear cushions, and an aviation leather helmet goes with each set! These are the only phones to pass the Government specifications for sensitiveness and loudness, the requirements called for in aircraft reception.



VARIOMETERS

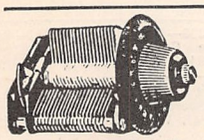
Diamond Lattice at $2.95
Moulded $3.65
$5 Value Mahogany Variometer $1.95

ELECTRIC SOLDERING IRON $2.45

Especially adapted to radio work. Simply attach to any light socket 110-120 volts. Complete, with six foot cord and attaching plug. Lasts a lifetime for ordinary home or light shop work. A real bargain.

MAGNAVOX

Type R-3
New Style
$27.45



VARIABLE CONDENSERS

$7.00 value, 43 Plate Vernier $3.95
$6.50 value, 23 Plate Vernier $3.45
$6.00 value, 11 Plate Vernier $2.95
$1.75 value, 3 Plate Vernier $1.15
$4.30 value, 43 Plate **NOW** $1.75
$3.70 value, 23 Plate **NOW** $1.45
$3.30 value, 11 Plate **NOW** $1.35
$2.25 value, 5 Plate **NOW** $1.25

RHEOSTATS

Framingham ...35c
Klosner Vernier 85c
De Forest 85c
Remler 45c
Cutler-Hammer Vernier ...$1.35

Mueller Universal Battery Clips 10c
3 Coil Honeycomb Mountings, with knobs, at ..$3.95

COMPLETE PARTS FOR SINGLE TUBE REFLEX CIRCUIT $32.65

CONSISTING OF	Reg. Price	Our Price
43-Plate Vernier Variable Condenser	$7.00	$3.95
Radion Loop Aerial	8.50	5.95
Cunningham C301-A Tube	9.00	5.95
Grewol Glass Inclosed Detector	2.00	1.65
Erla Radio Frequency Transformer	4.50	3.45
All American 5 to 1 Radio Audio Frequency Transformer	4.75	3.95
2—.001 Micon Condensers	.70	.50
1—.002 Micon Condenser	.45	.35
Howard Potentiometer	$1.50	$1.35
Howard 25 Ohm Rheostat	1.10	1.00
8 Binding Posts	.80	.40
9x10½ Formica Panel	1.42	1.20
9x10½ Genuine Solid Mahogany Cabinet with hinged top	5.00	2.95

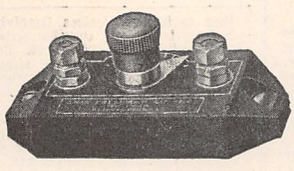
Complete instructions for drilling, assembling and wiring furnished so that any one with no technical knowledge can easily follow. Regular price, $45.22.

Our Price **$32.65**

Lightning Switches $2.65
Crystal Detectors 25c
Sterling Silver Cat Whiskers at 10c

Capt. Schoohoven Reinartz Coils $1.95

Switch Levers ..20c
Double Phonograph Adapters $1.35
Head Bands 50c
Phone and Grid Condensers at ..10c
Ground Wire, ft. ..1c
200 Ohm Potentiometers $1.35



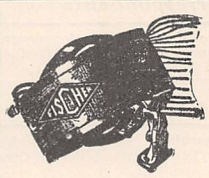
CABINETS

6x7⅜ by 6 inches deep $1.95
6x14 by 6 inches deep $2.45
6x16½ by 6 inches deep $2.95
6x22 by 6 inches deep $2.95
9x12 by 6 inches deep $3.95
9x10½ by 6 inches deep $2.95

Freshman Variable Grid Leak and Condenser, $1.00 value **65c**

HONEYCOMB COILS

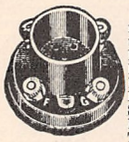
1,500 Turns, Coto-Coil $1.50
1,250 Turns, Coto-Coil 1.50
1,000 Turns 1.25
750 Turns 1.00
250 Turns, Coto-Coil ..... .75
150 Turns ..... .60
100 Turns ..... .50
75 Turns ..... .40
50 Turns ..... .40
35 and 25 Turns ..... .40
Rubber Spaghetti Tubing, yd ..... .10
Antenella—Use Electric Light Socket for aerial 1.15
22½-Volt B Batteries (stock replenished every day) 1.65
Dials—2, 3 and 3½ inch ..... .25
Ultra-Audion Bank Wound Coils ... 1.95
Grewol Detectors 1.45



VARIOCOUPLERS

180 Degree Coupling $1.75
90 Degree Coupling $1.95
Moulded Couplers, 180 Degrees at $3.45

FORMICA PANEL Black or Brown ⅛ inch thick, Square inch 1½c



VT SOCKET

Base ¼ inch solid sheet Celeron-Condensite Brass tube—nickle-plated and polished. Phosphor bronze contacts, nickled—all other parts brass, nickle-plated. Rugged, Durable, Lasting.
Single 35c
Double 65c
Triple 95c

HOMECHARGERS DE LUXE TYPE $13.45

Charges batteries at home over night for a few cents. Connect to any 110 volt or 60 cycles light socket, turn on current and rectifier does the rest automatically. Simple connections. Gives proper tapering charge.

SOLDERALL

Metal in paste form for mending wires and joints. Insures perfect reception—results equal to bar or wire solder 20c

Double Phone Cords 50c
Phone Caps for mostly all phones 25c
Composition Binding Posts 5c

Spaghetti Tubing priced at yard 10c
Potentiometers 95c

ORIGINAL BALDWIN PHONES

These are the Genuine Nathaniel Baldwin "Mica Diaphragm" Phones, complete with silk cord and headband. Special at $9.95

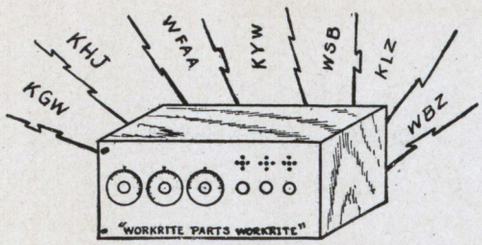
Genuine Baldwin "Mica Diaphragm" Type "C" Loud Speaking Units Special $4.65

We Guarantee All Merchandise Purchased of Us ***Mail Orders Receive Immediate Attention***

CHICAGO SALVAGE STOCK STORE

509 South State Street, Chicago, Ill.
Dept. RN-6

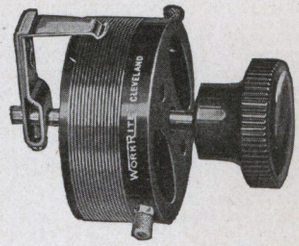
WHICH ONE DO YOU WANT?



USE
WorkRite Parts

And you can tune in on the station you want even with your local station in operation

New WorkRite Vernier Rheostat $1.00

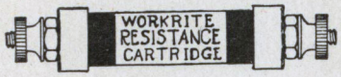


Here is an instrument that is the last word in Rheostats. 50,000 adjustments for $1.00. The drum is moulded and cannot shrink. No danger of the wires loosening. Easy to mount on panel. Pushing the knob way in turns off filament. Turning the knob gives the very finest adjustment. Often a turn of 1/32 inch will clear up a station or separate two stations.

WorkRite New Super Vernier Rheostat— 6 ohms.....$1.00
WorkRite New Super Vernier Rheostat—15 ohms.....$1.10
WorkRite New Super Vernier Rheostat—30 ohms.....$1.25

WorkRite UV 199 Tube Accessories Are Best

WorkRite Resistance Cartridge



No need to buy a new Rheostat to get the 30 ohms resistance required for the UV199 Tubes or the 15 ohms for 201A and 301A Tubes. Just put a WorkRite Resistance Cartridge on the circuit with your old 5 or 6 ohm Rheostat. Price—15 or 30 ohm **40c**

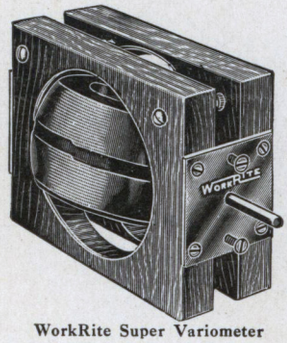
WorkRite UV 199 Non-Microphonic Socket

Here is the right socket for your new UV199 Tube. It is moulded with a sponge rubber base in one piece which is even better than the soft rubber recommended for use with this tube. Don't look any further. Get some of these sockets right away. Price **60c**

WorkRite Hydrometer

Double the life of your battery by giving it proper care. Fill and test it regularly with a WorkRite Hydrometer. Never let it get below 1150. Full instructions for testing and care of battery with each "WorkRite." Get one now. Price **75c**

WorkRite Tuner Team

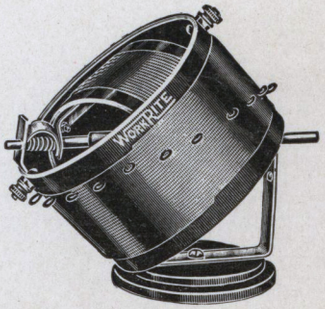


WorkRite Super Variometer

Tunes Out Local Stations and Gets the Station You Want

Two WorkRite Variometers and one WorkRite Variocoupler make up the Famous WorkRite Tuner Team about which the whole country is talking. No difficulty to separate stations and bring in the one you want clear and loud. The coupler is made from moulded Bakelite and wound with green silk. The Variometer is made from polished Mahogany; has a range of 200 to 760 meters. Make up a set with WorkRite parts and see what a *real* set is like.

WorkRite Super Variometer each .....
WorkRite 180° Super Variocoupler each **$3.50**



WorkRite 180° Super Variocoupler

Other WorkRite Radio Products

WorkRite E-Z Tune Dial. Has a knurled flange on outer edge giving firm grasp for fine tuning. Price .....75c.
WorkRite Concertolas. Loud Speakers of Quality. Carefully made.
WorkRite Concertola Jr. $12.00
WorkRite Concertola Sr. $24.00

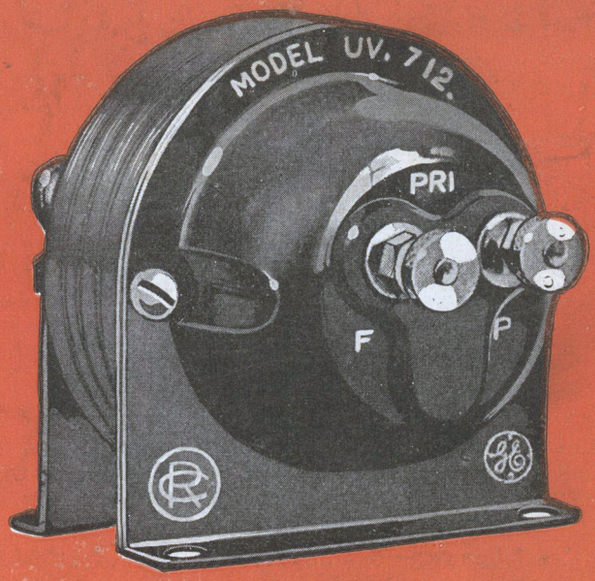
WorkRite Switch Set. Complete switch set in one unit. Parts made to work together. Use block for template in drilling plate. Price .....50c.
WorkRite Head Set. Extremely sensitive and free from distortion. Compare it with any on the market. New Price $6.00

"WorkRite Radio Parts WorkRite"

THE WORKRITE MANUFACTURING CO.

5515 EUCLID AVENUE **CLEVELAND, OHIO**

(Branch Office, 536 Lake Shore Drive, Chicago)



Transformer
UV-712
$6.50

Volume—undistorted!

With Audio-Frequency Transformer UV-712

—Complete shielding to prevent interaction between fields.

—Sturdy build to withstand rough use and much handling.

—Exact construction to eliminate distortion in each stage of amplification.

—Special care to minimize transformer losses, which gives unequalled volume.

RCA

This symbol of quality is your protection.

Particularly Designed for Use with RCA Radiotrons

Radio Corporation of America

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